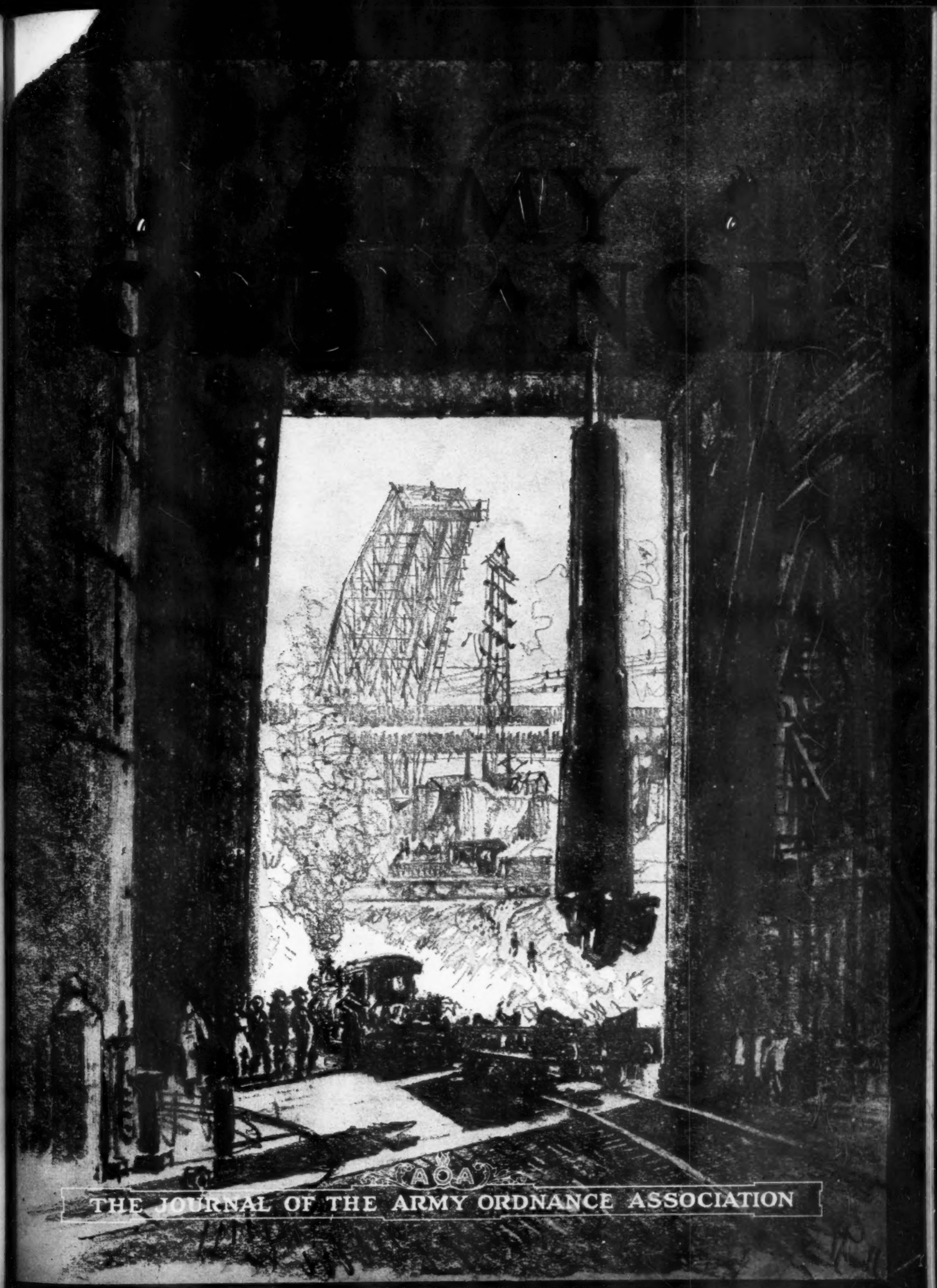
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ARMY ORDNANCE

The Journal of the Army Ordnance Association

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

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"When we consider that war brings with it an abnormal demand for commodities which range from foodstuffs, clothing and guns to automobiles and railway locomotives we realize the tremendous load that war places on industry and the vital dependence of military strategy on industrial effort. And this demand takes place when industry is least able to meet it—handicapped as it is by withdrawal of men for military service and by the necessity of adapting its factories to the production of articles with which they are possibly unfamiliar. And yet the additional load must be carried with as little interference with the needs of the civilian populations as possible."

Patrick J. Hurley, *The Assistant Secretary of War.*

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THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our Nation's strongest guarantee of peace.

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ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the Nation's strongest guarantees of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the Nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect cooperation with American Scientists, Inventors, Engineers and Manufacturers in civil life and the Regular and Reserve Officers of the Army Ordnance Department;

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

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To commemorate the services rendered by the Industry of the Nation and by the Officers and Civilian Employees of the Ordnance Department in the wars in which the United States has been engaged.

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Hugh S. Johnson

Soldier, Lawyer, Manufacturer

GRADUATE Oklahoma Northwestern Normal School, 1901; U. S. Military Academy, 1903, A. B.; University of California, 1915, J. D. 1916. Commissioned 2nd Lieutenant 1st Cavalry, 1903. Served through grades to Brigadier General 1918. Resigned from military service 1919. Vice-president, general counsel and assistant general manager Moline Plow Company; organizer and chairman of board Moline Implement Company. Served as quartermaster for refugees San Francisco fire, 1906; in Philippines 1907-1909; executive officer Yosemite National Park, 1910-1912; superintendent Sequoia National Park, 1911. Judge Advocate under General Pershing, Punitive Expedition, Mexico, 1916. Assistant to law officer, Bureau of Insular Affairs, 1917; deputy provost marshal general, Washington, D. C., 1917. Colonel, War Department General Staff, 1918; Chief, Purchase, Storage and Traffic Division, General Staff, and member of War Industries Board, 1918. Awards: Mexican Campaign and World War medals; Distinguished Service Medal "for work on selective draft." Author: Williams of West Point, 1907; Williams on Service, 1909; Selective Service Regulations and Questionnaire, 1917.

ARMY ORDNANCE

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Fallacies of "The Universal Draft"

And the Equitable Way to Mobilize Industrial America in War

By Hugh S. Johnson

RISK of national existence on the hazard of only a fragment of national defensive strength is a thing of the past. No nation will ever again enter a major conflict without at least *some* provision for the mobilization of its entire resource of men, money, morale and matériel for the single purpose of victory.

Mobilization of men bases on principles and presents problems widely varying from those incident to mobilization of things or mobilization of mind and spirit. This difference is apt to be overlooked. Because, in the World War, we classified our man power in the order of the relative value of its various groups to military and industrial uses, and selected for service with the colors those most available for that duty and because coincident with their marching there was profiteering, inordinately high wages and a vast inefficiency due to insufficient control in industry at home, the casual commentator is apt to conclude, "Do with property, employment and dollars what you did with soldiers. *Draft* every dollar, every man and every thing." It has a lilting sound. It seems a practical Alexandrian slash at a Gordian knot of far more numerous and tangled strands than the one in Phrygia. It has become a sort of shibboleth. It parades under the formula, "*The Universal Draft.*"

What is being striven for by the proponents of this idea is a plan for a compact and scientific organization of our country—justly, equitably and without economic chaos—as a true "Nation-in-Arms" in the event of future conflict. The end is certainly laudable and we learned enough in 1918 to know it to be attainable. But, as to the road toward the goal we also learned the paths that ended in *culs-de-sac* and those that promised something of success. Those lessons seem to have gone glimmering in many minds. "The universal draft" in the sense the words are here used is utterly impracticable. It violates principles of political economy and civil and economic organization which condemn it at the outset and mere dalliance with the words raises dangers that threaten to overwhelm any modern organization of our defense at all. There is another and a far better way to reach the same result. It is the purpose here to consider the fundamental principles that govern drafts, to outline their subversion by this shibboleth and finally to show the way to the desired end by paths that avoid these dangers yet attain these ends.

THE draft of man power for military service is an established success. Sociologists say that the inception of human society was a weariness from violence, thievery and murder among family groups and the obvious relief secured by banding together of such groups in a pool of man power to resist attack—the primal social compact, the organic and underlying principle of civilization. It requires no reasoning to support the thesis that the burdens of this principle run with its benefits. When danger comes, no man who has lived in the peace of its protection can say, "But *now* I do not choose to fight." Stated simply: The obligation to military service is universal and inevitable. It has been so from time immemorial. It was basic in the Saxon laws which are the springs of our institutions. It was inherent in the Common Law of England and has been declared by England's courts. It is explicit in our Constitution and has been repeatedly and clearly expounded by our Supreme Court. It is definite in the Hebraic Law and at Deuteronomy 20[5] and First Samuel 30:22-25 will be found an early Selective Service Act. Were it not thus crystallized in the political history of the world it would be a logical and inevitable principle of any scheme of society or civilization, crude or complex, new or old, invented or evolved.

Another point which seems to be overlooked entirely and which differentiates the appropriation of men for national service from the appropriation of things is that this service is *payment for benefit already received from the protection of the nation;* it is not something the nation takes with an implied promise to pay for it. It is the discharge of an obligation by the individual not an incurment of obligation by the nation. The contract was made when the man accepted the benefits of his government and under the immemorial compact to which we have referred it subsists as long as danger threatens that government. This has a heavy bearing on the question of reward.

Nothing of this is so of things and dollars. Especially as to the latter, the drafting of dollars in the sense of taking them from their owners and devoting them to public use can be reduced to absurdity by reference to one single sentence in our Constitution: ". . . *nor shall private property be taken for public use without just compensation.*" Now there may be room for arithmetical or actuarial argument over what constitutes *just compensation* for a thing taken, but of a dollar, which is in itself merely a measure of value, there can be no argument. Just compensation for a dollar taken is a dollar given. Drafting dollars would have to consist of taking them away and giving them back. No wars could be won by that process. Of course dollars may be taken by taxation even to the last stiver of any man's wealth and the power to tax is not only the power to destroy but also ultimately to appropriate, but that is another question which we shall address hereafter.

It is also true (in a different degree) of *things* taken that the taking must be compensated. Our government can take (and repeatedly has taken) property for the purposes

of war, but for the same Constitutional reason, it cannot take property without paying for it. In the case of a soldier it can require his services or even his life and it can assess its own figure of reward even down to zero. In the case of property it can do no such thing.

Nor is the argument here merely legalistic. The difference is as old as the inception of the idea of universal obligation to military service. Communism has never been adopted by humanity. For just as long as there has been an idea of implied obligation to personal military service in time of common danger there has been a doctrine of inviolable ownership of things. Indeed the former was evolved to protect the latter.

WHETHER or not this be harsh doctrine it is a fact to face, and it is a fact as deeply rooted in our policy as any there residing. The world may some day come to communal principles governing tenure of property, but it is not there now and if our projects for defense are not practical they are nothing. We deal with the present. Plans conceived in the leisure of peace which involve revolutionary principles—radical overturning of age-old conceptions—to be invoked like full-fledged genii upon the first sudden alarm of war are lunatic because they insure tragic upheaval within our walls at the very moment when the enemy is at the gates. They are exactly like the episode in Russia—the nation which paused in the midst of war to institute a communistic regime which has nearly destroyed her. Whatever plan evolves for economic organization of national defense it must not start with this.

Nor is the doctrine of the present necessarily harsh. Whether or not he frames it in heroic words—or any words at all beyond profane soldier epithets, picturesque beyond description and in outward seeming far less heroic than silence—the man who turns his back on every material benefit to hazard his life for his country is moved by spiritual considerations and by those alone. And whether his conscious motive be spiritual, his act is. Its measure of value is not monetary. On the one hand, "just compensation" for it could never be assessed; on the other, it is not the sale of a commodity, it is the performance of a duty—nearly the highest duty that civilization has evolved. We cannot buy such devotion; we cannot limit, measure or weigh it out. To try to do so would be to destroy it.

In sum: we can, should and must accept and demand military service without monetary evaluation; we cannot confiscate property without just compensation.

THIS raises the intermediary question: If the nation goes to war as a unit—if the men who remain in industry are as much a part of the national war team as the men who march with the colors—why should not the same principles apply at least to both of these cases? Why should men in industry, in whatever capacity, be rewarded by inflated war wages which they may accept or decline in their own discretion? Why should they not be drafted on exactly the same principle as soldiers?

That they should be inordinately rewarded is unnecessary, wrong and easily avoidable, but *not* by drafting men to work for other men. A soldier serves the nation directly. There is but one master in the case and that master is America. He serves to profit no one but the country as a whole. There is no distinction between him and his comrades. He enters an immemorial status. His entry is not contractual. He is clothed, fed, housed and attended. As long as our present industrial organization maintains, industry is in the hands of millions of private masters. It is operated for profit to those masters. The employee therefore serves a private master operating for gain. Enforced and involuntary service for a private master is and has been clearly and repeatedly defined by our Supreme Court as slavery inhibited by the Fourteenth Amendment to the Constitution of the United States.

If all agriculture, finance, commerce and industry were nationalized, if private ownership were abolished, then the drafting of all men for industrial service would, in the modern concept of war, be on exactly the same footing as drafting them for industrial service. But until that day—and that also is the day of communism—this thing is impossible and for reasons already stated no plan based on such a reversal of principles so deeply embedded in the history of our race should be given even momentary consideration. The control of industry for war purposes is a separate problem to be presently considered. The drafting of men to work in specific places and at specific tasks for private masters is impossible.

This does not say, however, that men not under military discipline are free agents in war. The government cannot say, "Work here. Work there," or "Work for Mr. A." But it can say—as it did say in 1918: *"Work or Fight!"* That principle was barely invoked but it was and is capable of immense expansion. In brief it is this. The government can specify classes of employment which, in emergency, women, men without the draft age limits and men not fully capacitated for military service are sufficient. It can specify whole classes of employment which are not considered essential and can then say, "Every man not in military service—whatever may be his domestic or other circumstance warranting deferment or exemption—must be, usefully and faithfully employed in an occupation essential to the military purposes of the nation. It can go much further. It can say that if a man be called and found unfit for military service but fit for other work in the essential lists, he must so employ himself or be cut off from rations, transportation, fuel and supplies. Also, in the organization of the nation, here considered, there is the force of public opinion more potent than any governmental compulsion. If our organization for the next war proceeds from the lessons learned in 1918, our man power will be so classified and organized that no man can shirk and show his face among his fellows.

Thus, the draft of men for industrial employment is both impossible and unnecessary. There is a better way which is compatible with our institutions and far more effective than any chain-gang or impressment that could be invented. The evil of inordinate wages is for the moment reserved. It is eradicable.

INDUSTRY in the United States is a delicate pattern of interrelated strands. It has been evolved in response to the needs of the Nation and under natural economic laws but dimly understood and subject to arbitrary and artificial interference only at the risk of starting a sequence of upheavals the ends of which no one can foresee. It is guided and operated by men who have attained their places in a fierce economic struggle for survival and generally these

men are where they are because of demonstrated fitness. The difficulty of replacing good men and the evil of appointing poor ones even in peace-time administration is warning enough against wholesale replacement under the terrific added stress of war.

During the World War it was thought by some that the Steel Corporation was not complying sufficiently with governmental instructions and a project was bruited for "taking over" (conscripting, confiscating or drafting) the U. S. Steel Corporation. It split on the rock of this argument:

"Who will run it? Do you know another Judge Gary? Would you replace a proven genius by a problematical mediocrity? And after you 'had taken it over' and installed your man, what greater control would you have than now? *Now* you can choke it to death, deprive it of transportation, fuel and power, divert its business, strengthen its rivals, do far more than seize and pay for it. If you 'take it over' you can only give orders with far less sanction than you can give them now. The fault is yours. Let Judge Gary run the Steel Corporation and you run Judge Gary. If you can't do that with your almost boundless power it is you who should be 'taken over'—not the Steel Corporation."

This argument seems unanswerable on the question of "drafting industry."

By the Priorities System, the control of prices and the ever present and little-used threat of confiscation, the Government, in 1917-18, literally rationed to industry the wherewithal of life and there is no doubt that in another great emergency the same powers would be used. The problem of controlling industry no longer resides in unknown territory. The question is administrative merely and not organic.

THIS brings us to the all-important problem which bases the ill-considered demand to *"draft everything"*—the problem of high prices and profiteering. In the last eight months of the war control of American industry was neatly bundled and dropped in the lap of Bernard Baruch, chairman of the War Industries Board. He had studied the problem for years and he brought to its solution as keen a mind as has ever functioned in such a field. Our Allies or "Associated Powers" had been buying in our markets for three years. "War babies" in industry were already familiar phenomena. Wages had passed the bounds of reason. Yet, after some careful weeks of cut-and-try, Mr. Baruch began to apply controls which, at the Armistice, had become effective. He is a partisan of peace yet, since the war, he has devoted his talents to studies based on its lessons and has propounded a thesis on "Taking the Profit Out of War."

The idea is simply this. In the event of actual or threatened major conflict the President is to have power to set up an organization of industrial leaders, patterned on the War Industries Board minus its certain mistakes. He is also to be empowered to proclaim that wages, prices, and interest rates shall be crystallized in that schedule which subsisted at a fixed date long enough before the emergency to insure that they were then influenced by the normal operation of the law of supply and demand under conditions of peace. Thereafter particular changes in this schedule shall be made only with the sanction of the Board.

There must be lodged somewhere the power to provide, for the extraordinary demands of war, prices high enough to bring in the ultimate sources of new production and the inevitable seat of that power is the War Industries Board where all controls center, where all information is available.

There has as yet been evolved only one way to meet the situation presented by this price-incentive requirement—the excess-profit tax. Its imposition involves serious accounting problems but progress in this art since the war (and especially since the remarkable awakening of public interest in the stock market) has been amazing. That tax is the great leveller. We shall see no profiteers in the next emergency. Return for industrial effort will be rendered uniform on a scale no higher—and perhaps lower—than the peace-time schedule.

ENOUGH has been said to base a statement of the eventual pattern of war organization for this Nation. It is this:

(1) A "Selective Service" law classifying our man power and designating those who shall serve with the colors and those who shall take their places in the most powerful war weapon the mind of man has yet conceived—industrial America organized and administered as a single economic unit addressed to the purpose of defense.

(2) A "Work-or-Fight" statute which shall eliminate idleness and insure the useful employment of every citizen in that place to which it shall best serve the common good to call him.

(3) A "War Industries Board" composed of the very cream of American industrial leadership and vested with control of prices, transportation, power, communications, raw material, the issue of securities, the use of money, foreign trade, building and the principles of exemption, deferment or industrial allotment of the Selective Service Law.

(4) Power in the President to proclaim that schedule of wages, salaries and prices subsisting at the latest date anterior to the emergency when the national schedules of these values can reasonably be said to have been determined by the normal peace-time operation of the law of supply and demand subject to change only under sanction of the War Industries Board.

(5) An excess profit tax levelling the rewards of industry to a plane where—whatever burdens war may bring—it will carry undue enrichment to none.

CONTRASTED with the confusion and failure certain to follow any attempt to put government in direct bureaucratic administration of the industrial mechanism of the United States, to force the involuntary employment of people in industrial tasks contrary to their will or their experience, to administer the delicate economic pattern of the United States by a fiat of mediocrity, there is nothing to choose. This is the system that war will evolve in America because it is the right system and the only system. The sole question is: will it be evoked too late? Will we enter the next emergency clogged by some statute born of an easy catch-word and imposed in peace as the expedient of politicians to meet an ill-informed and popular demand to "draft everything"? May the genius which watches over the fate of America forbid!

Mechanization in Europe

Part II: Great Britain

By C. C. Benson*

THE British expect mechanization to overcome the dominant power of the defensive and to restore decisive maneuver in battle. Their present Director of Mechanization, Maj. Gen. S. C. Peck, C. B., D. S. O., sums up the situation thus:—" * * we are in a purely experimental stage—feeling our way; but personally I am convinced that mechanization has come to stay. It is the pivot around which future armies must organize * * *." The fighting machines that first appeared in action on the Somme thirteen years ago have risen to high estate. In Great Britain at least, their technical improvement has kept pace with the rapid progress of automotive industries; and their tactical employment has become a matter of prime importance. Mechanization experiments, inconclusive as yet, have already worked a miracle—they have shifted the focus of military thought from the past to the future. Old methods are giving way to new; but in the present transitional period, no one can say definitely what effect the motor will have on the battlefield of tomorrow.

British Mark I Tank in Initial Action, September, 1916.

BRITISH enthusiasm for fighting machines began with the men who saw the first tanks in action. A soldier's letter, written in September, 1916, and widely circulated in England at the time, gives a vivid impression of the amazement and delight with which those early tanks were received. "They can chew up barbed wire and turn it into munitions. As they run they slash their tails and clear away trees, houses, howitzers, and anything else in the vicinity. They turn over on their backs and catch live shells in their caterpillar feet, and they can easily be adapted as submarines; in fact, most of them crossed the channel in this guise. They loop the loop; travel forwards, sideways and backwards, not only with equal speed but at the same time. They spin around like a top, only far more quickly; dig themselves in, bury themselves, scoop out a tunnel, and come out again ten miles away in half an hour." Slow, unwieldy, and mechanically unreliable though they were, some of these early machines crashed their way through strong German defenses; they terrified the German front line troops, and renewed British hopes for release from the hell of trench warfare. German leaders heaped scorn on their first clumsy efforts; but had they realized the moral effect of these machines, they might have come closer to estimating the true value of the new weapon.

The tanks, having successfully passed their initial battle test, were rapidly improved. Sir Albert G. Stern in England and General Estienne in France independently fostered the tank idea, and it was largely through their individual efforts that the "chariots of assault" developed into effective weapons. It required, however, the smashing attack of nearly 500 heavy tanks at Cambrai to convince the Allied leaders that this new weapon could overcome the power of the defensive. From then to the end of the war, the Allies employed tanks in increasing numbers; and had the war continued, 1919 would have witnessed great battles with tanks in the leading role. When the Armistice was signed, work was in progress on 3,500 French light tanks, 5,000 British heavies, 1,500 British-American extra heavies, and 21,890 tanks of various types for the American Army. *A total of over 30,000 tanks would have been ready for action in the Allied armies in the Spring of 1919.* Germany was making strenuous though belated efforts to supply her forces with tanks. Few military men knew the extent of the tank program that was under way when the war ended; and right now there are even fewer who would know how to use 30,000 tanks. Even when employed in limited numbers, tanks had established the fighting machine as a powerful offensive weapon. They helped to restore movement to a situation that had become rigidly stabilized; reduced materially the casualties of attacking infantry; lowered German morale and raised that of the Allies; and pointed the way to one sure line of future development.

THESE costly lessons from combat experience have stuck by the British army. It ended the World War with the best tanks then in existence, and definite ideas on how to use them. Since the war, Great Britain has spent large sums to develop better fighting machines and improved tactical methods. Her responsible civil and military leaders are definitely committed to the policy of extensive mechanization for Regular Army units; she has the necessary scientific and industrial resources to equip, man, and

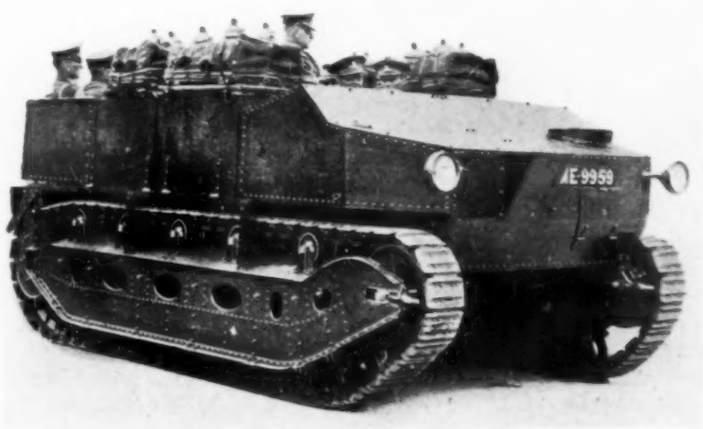
*Historical Section, War Department General Staff. Major Cavalry, U. S. Army.

maintain large mechanized forces. There are naturally differences of opinion on when and how to apply this policy, and the usual dearth of peace-time funds for the necessary changes. Measures already taken have undoubtedly placed the British in the forefront of mechanization progress, and there they propose to stay.

Lanchester—Much More Heavily Armored Than Previous Models.

Before going into the details of this subject, let us consider some of the factors that affect the British mechanization plans. Industrially, the World War was disastrous to Great Britain. Her complicated industrial machinery was thrown badly out of alignment for commercial purposes; the progressive substitution of oil for coal, and extensive boycotts in India and China on British manufactured goods, made matters worse. Furthermore, British manufacturers have had to meet stiff competition from European and American producers. For ten years, unemployment has been, as it still is, the most vital domestic problem of the government. Within the past year, conditions have taken a turn for the better; and though there are still over a million workers unemployed, business is picking up. Despite hard times, the British found money for army mechanization experiments and improved industrial conditions will probably bring more liberal appropriations.

The peculiar situation of the British army hinders any radical change in organization. The Cardwell system binds home organizations to similar units in India; and so long as this system remains in effect, the organization, equipment, and training of the correlated units must be such as to make them interchangeable. In India, the most likely scene of conflict is on the northwestern frontier, in a mountainous region entirely unsuited to machine warfare; consequently, the Indian Army authorities are loath to accept the full measure of mechanization that is desired for home units. These home units may at any time be united into an expeditionary force for service in a theatre of operations where conditions differ materially from those in India. Clashes between Moslems and Jews in Palestine may require Great Britain to send an expedition to preserve order there. Detachments of aircraft, armored cars, and motorized foot troops have already been dispatched to the danger zone. British commitments under the Locarno Pacts indicate Europe as another possible theater of war. There the terrain is generally suitable for mechanized warfare; moreover, a British expeditionary force could rely upon the coöperation of allied troops organized on traditional lines. Under these circumstances, the expeditionary force might well be completely mechanized. The British improvised a Tank Corps during the World War, and an excellent job they made of it; but no such deliberate measures will do for an expeditionary force. It must be ready to go quickly when the need arises. Hence the protagonists of mechanization urge the immediate organization of strong mechanized units. The British War Office, prodded by enthusiasts at home and repressed by conservatives in India, is in a quandary. Its efforts to reconcile divergent but interdependent interests will take time, and until a satisfactory settlement is reached, British plans for extensive mechanization will be handicapped.

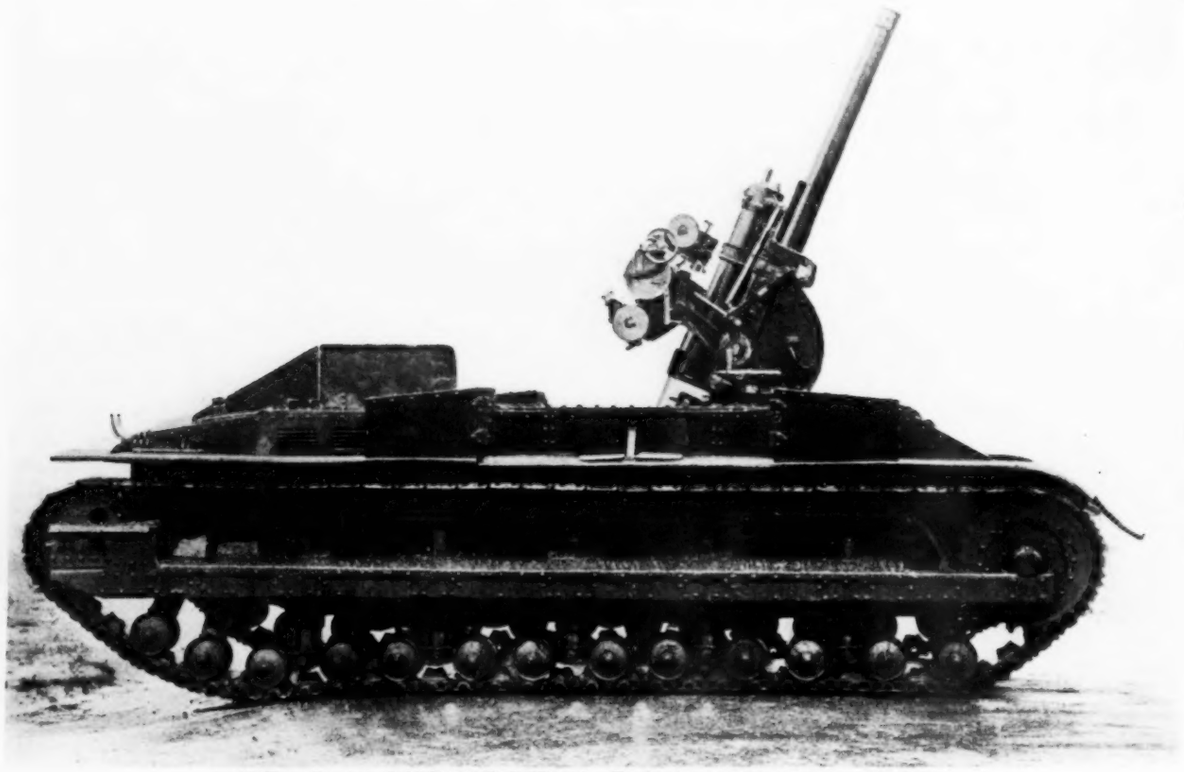


Dragon Mark III—Adopted as Tractor for Medium Artillery.

IN the meantime, experiments in mechanization are under way in England. Fortunately for the progress of these experiments, the British Tank Corps has enjoyed a continuous existence ever since its creation as a new combat branch during the World War. It has preserved the high ideals of service that characterized the Tank Corps, pioneers, and has given continuous study to the organization, equipment, training, and tactical employment of mechanized units. Tank Corps units are not normally included in corps or divisions; they are considered as part of the G. H. Q. reserve. The Tank Corps at present includes only four tank battalions and eleven armored car companies; but these units are well equipped and have had a great variety of practical experience in England, Egypt, India and China, in the mechanical and tactical operation of their vehicles. They are well qualified to set the standard for whatever mechanized forces are organized.

The first of these forces, a mechanized brigade, was formed in 1926 to study the organization and tac-

tics of a unit equipped with armored fighting machines. During 1927 and 1928, this force participated in maneuvers with infantry divisions and cavalry brigades. Having learned what they could from the operations of this force, with the equipment available, the War Office disbanded it. The 1929 program involves a number of experiments with the details of organization and equipment of various small units, but is principally concerned with a combination of motorization and mechanization as applied to two infantry and two cavalry brigades. Tests of various machines, including self-propelled gun mounts, already begun with two field artillery brigades, are to continue. This apparently radical change in the development of mechanization projects indicates expediency rather than policy. The Armored Force was discontinued in order to make its component units and vehicles available for important work in other closely related fields. As in our own service, the real problem of mechanization is to work fighting machines into tactical thought and practice of the army. When the older branches accept partial mechanization for their own purposes, they will better appreciate the need for separate fast-moving mechanized forces, and will understand how to co-operate with those forces. By enabling the older branches to educate themselves, British mechanization experiments of this year will have a far reaching influence upon the army as a whole.



18-Pounder on Self-Propelled Mount. Early Type Dual Purpose Weapon.

SO much has been written about the British mechanized maneuvers, by observers and particiipants, that it is hardy worth while to recount the details here. However, some items that apply to particular branches are of special interest.

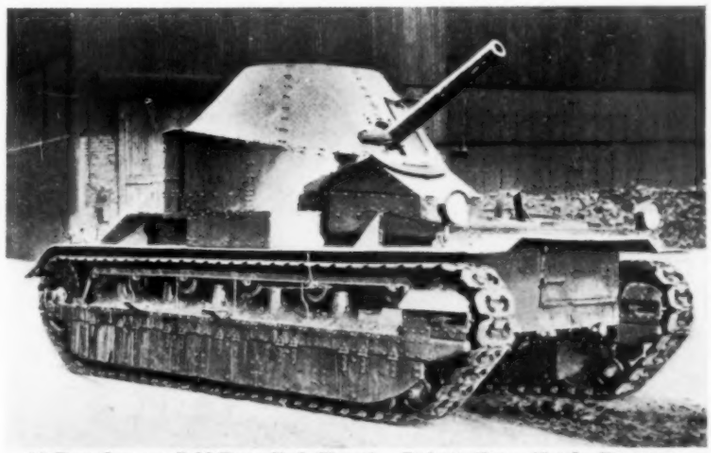
Cavalry

For close reconnaissance, the British consider the horse soldier indispensable and irreplaceable. Nevertheless, two cavalry regiments have had their horses replaced by armored cars. All of the home cavalry regiments have been supplied with light six-wheeled trucks for their first line transport. Each of the two cavalry brigades employed in the 1929 mechanization experiments has Carden-Loyd machine gun carriers in place of the light six-wheelers previously used; some "Baby" Austin scout cars for use on reconnaissance; and a mechanized 3.7-inch howitzer battery. On the march, the howitzer carriage is mounted on a caterpillar trailer which is towed by a Carden-Loyd. This rig appears to be awkward but it is reported to work well enough for experimental purposes. These cavalry brigades are assigned duties, particularly in difficult country, for which completely mechanized units are unsuitable.

The present British armored cars have limited ability to surmount obstacles encountered on the road, or to maneuver across country except on the most favorable terrain. The Rolls Royce car weighs 8,300 pounds; and the new Lanchester, with much heavier armor than heretofore, 13,500 pounds. Several different models of the wheel-and-track type have been tried without much success, but experimental work along this promising line continues. The service machines carry less armor and fewer weapons than tanks; they are, however, silent, fast, and reliable mechanically. Their great radius of action makes them particularly suitable for long distance reconnaissance. Where the terrain permits, armored cars are used on many of the security and reconnaissance missions that were formerly assigned to cavalry detachments.

Engineers

Remarkable progress has been made in the development and use of bridging equipment, including pontoons, for mechanized forces. The pontoons are light, collapsible, and can be conveniently nested. The roadway of the pontoon bridge is made with duckboards that can be placed in position quickly. It is proposed to carry the pontoons and some of the heavier materials on specially constructed trailers. The engineer units of the mechanized formations are provided with six-wheeled trucks, and have power-driven tools to supplement their normal equipment.



18-Pounder on Self-Propelled Mount. Latest Type Single Purpose Weapon. Antiaircraft Guns Now Have their Own Special Mounts.

Chemical Warfare

All mechanized force troops have been equipped with training gas masks. Exhaustive tests have demonstrated that tanks can be operated successfully under all expected field conditions by men wearing gas masks. The Superintendent of the British Chemical Warfare Research Department states, "We satisfied ourselves that it would be impossible to get in the field a sufficient concentration to appreciably affect the engine." To make tanks gas tight, and to provide adequate ventilation at the same time, is considered impracticable at present. The tank developed most recently, Vickers 16-ton, model 1928, has no special provision for protection against gas.

Experiments have been conducted with Carden-Loyd machines as carriers for smoke-producing devices; but though the smoke produced was satisfactory, this line of development has received no encouragement from the Tank Corps. An armored vehicle with a weapon that can fire smoke shells, either when in motion or stationary, is considered more useful than the smoke-producing machine.

Signal Corps

Radio telephone and telegraph have been developed for armored fighting machines, and have been in successful use since 1926. Short orders, suitable for drill and maneuver purposes, are sent readily by radio telephone. Changes of formation, direction, and speed of the fighting machines can thus be directed and controlled in a way that permits full utilization of their mobility. The use of signal flags within platoons has been tried and found wanting; at high speeds visibility is none too good at best and when fog, smoke, or dust interfere, the signal flags are useless. Two standard radio telephone sets are in use; one, powered by a gasoline motor, has a range of over fifty miles; the other, for which accumulators provide the power, has a range of five miles. Both can be used for wireless telegraphy with greatly increased ranges. Even with these facilities, which are probably better than those of any other army, the British are still confronted with many unsolved problems connected with the control of mechanized units.

Successful tests have been made with a Vickers gyroscopic direction indicator. It is said to be a non-magnetic, compressed air operated device, which is far more reliable than a compass for the navigation of a tank.

Artillery

Must we still figure in terms of six-horse teams when powerful motors are available? Why the 3-inch gun for divisional artillery? If the motor can be used, why hitch it to a comparatively light weapon? To what extent can motors increase the power and mobility of artillery? These are a few of the questions that British experiments have aroused.

Extensive tests have been made with wheeled and half-track tractors, trailers, armored caterpillar tractors (dragons), and self-propelled mounts. All mobile antiaircraft artillery is now motorized, the guns being mounted on trailers which are towed by six-wheeled tractors. Antiaircraft equipment for the 1929 experiments includes machine guns and antiaircraft guns mounted on special cross-country carriers. The carriers provide armored protection for the engine, the driver, and for the members of the gun crew except when operating their weapons. Two 3.7-inch howitzer batteries, for the close support of cavalry, have been experimentally provided with caterpillar trailers of the Carden-Loyd Mark VI machines. Three brigades of field guns have been motorized with Burford and Crossley half-track (Kegresse) tractors, and "dragons." The dragons are apparently in excellent standing at present, presumably because they do the work and fit neatly into the mechanized force. Weight, about 9 tons; speed, 16 miles an hour; capacity, 11 men, 128 rounds of field gun ammunition, and a 3.3-inch gun in tow; engine, air-cooled, the same as used in the medium tank. The latest model dragon has proven satisfactory as a tractor for medium artillery, and has definitely been adopted for that purpose.

Experiments with self-propelled mounts for various artillery weapons have been continuous since the World War. The most recent development is probably the three-inch mortar mounted on a Carden-Loyd Mark VI. Two batteries with these experimental mounts are being tested for use in the close support of infantry. Self-propelled mounts for field guns have had their troubles. The first type produced carried a gun that could be used either as a field piece or an antiaircraft gun—weight, 12 tons; speed, 15 miles an hour; capacity, one 18-pounder gun, 6 men, and 1,750 rounds of ammunition; engine, air-cooled, the same as used in the medium tank. A second model gave the crew some protection. The latest model has abandoned the dual pur-

pose idea; it provides simply an armored field gun on a tank chassis, and is in fact nothing more nor less than a tank.

Some batteries are now equipped with radio telephones. To provide transportation for battery headquarters and instruments, a car with a specially designed body is to replace the touring car formerly used.

Carden Loyd Machine Gun Carrier. Mounts Either .303 or .5-inch Gun.

Infantry

The following significant change appeared in the 1926 revision of the 1924 training regulations:

1924—"Infantry in the end wins battles. To enable it to do so, the coöperation of other arms is essential. Separate and independent action by the latter cannot defeat the enemy."

1926—"The proper coöperation of all arms wins battles and enables the infantry to confirm the victory."

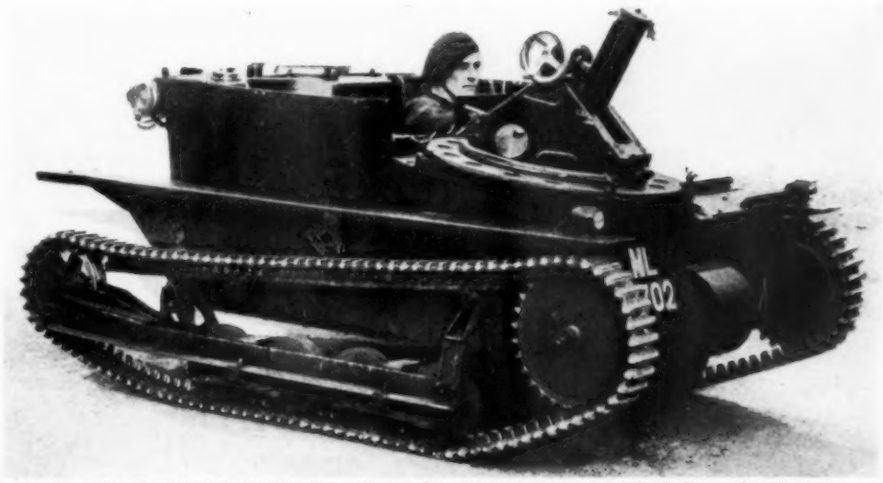
What this change connotes is a question that British captains are called upon to discuss as part of their promotion examination.

The infantry was represented in the Armored Force of 1926-27-28 by one battalion—three machine gun companies of twelve guns each, and one rifle company. Six-wheelers and half-track trucks were used for transportation. The 1929 experiments involve the partial motorization of two infantry brigades—the 6th at Aldershot and the 7th at Tidworth. The infantry battalions of these experimental brigades are not motorized. These tests include the use of Carden-Loyd armored tractors and caterpillar trailers for the transportation of men, ammunition, and weapons. The tractor is comparatively slow, but inconspicuous, light, simple and cheap. It provides partial armored protection for the driver and gunner, and carries either a .303 machine gun with 3500 rounds of ammunition, or a 3-inch mortar which has a range of 2,000 yards. The machine gun can be fired from the machine, but normally, as with the mortar, it is dismounted for firing. When traveling at six miles an hour, the carrier is so rough riding that it would be difficult for a machine gunner to hit a haystack a hundred yards away. The trailer can run on either wheels or caterpillar tracks; accommodates four men or extra ammunition as desired; and when equipped with tracks, has good cross-country ability. The .8 antitank gun, on its own trailer mount, is towed by the tractor; the .5 antitank gun can be mounted on the tractor. All these weapons are intended for the close support of the infantry. Their tactical uses, as well as the best methods of transportation, are being worked out. In addition, the attachment of a light tank battalion to each of the experimental infantry brigades will help to decide whether tanks should be an organic part of the infantry brigade. The idea that fighting machines must actually accompany associated troops has lost ground, but infantry commanders are not yet ready to concede this point. Tactical ideas change slowly, but it seems futile to tie fast, bullet-proof, modern tanks to slow-moving unprotected infantry. Results of this year's test should throw some light on this question.

The following items from the *Army, Navy, and Air Force Gazette*, give an idea of the operations in which these brigades have taken part. Referring to a rear guard action of July 26-27, the Gazette says: "The Southern Commander * * * decided to make vigorous use of his light tanks. * * * Shortly after dawn * * * the whole of the Southern light tanks and the 1st Battalion The King's Own Yorkshire Light Infantry with motor-carried machine guns and mortars, passed over the flank and rear of Strawberry Hill in waves, covered by a battery of field guns firing over open sights. The attack consisted of a company of light tanks as the first wave. They were followed by the light infantry who, in turn, had two companies of light tanks behind them, the last of which was taken in flank by a company of Northern medium and light tanks coming southwards from the neighborhood of the Jolly Farmer Inn. There ensued a most entertaining melee in which the Carden-Loyds (simulating light tanks) dodged about like infuriated wasps, trying to elude their larger and heavier opponents. In the tumult and the dust, the task of the antitank gunners in distinguishing friend from foe became virtually impossible." Another rear guard action, August 30th, in which the Reds alone had fighting machines, elicited the following:—"Nothing had been heard of the Red medium tanks, and rumor says that they remained quiescent in Savernake Forest throughout the entire day and the early stages of the night. At this period the fog of war set in, and was in no way reduced by the presence of an effective Salisbury Plain mist which reduced visibility to less than fifty yards. An odd intermixture of friend and foe began which did not end until well after the cease fire. * * * Shortly after dawn, while the mist provided an excellent substitute for the natural darkness of the previous night, Red's medium and 'light' tanks were sent across country to intercept Blue's passage to the Roon crossings. At this point confusion became complete. The tanks found their way with exceptional skill to the point indicated * * * *. The infantry of the two sides became intermingled in a way which would defy the greatest skill in description possessed by an honest historian."

Tanks

The British have as yet no light tanks, though a 5-ton caterpillar machine, designed for a maximum speed of 30 miles an hour, is now under construction. Particular effort is being made to develop light tank tactics by using a number of Carden-Loyd Mark VI machines to simulate light tanks. These machines are agile and inconspicuous, but are only partially armored and lack the ability expected of a light tank to surmount obstacles. The one-man machine, that caused quite a stir two years ago, is now in disfavor because its operation imposed too great a burden on the driver-gunner. Even the lightest machines, Morris-Martels and Carden-Loyds, are now designed as two seaters. Some 250 of these machines were available for the 1929 experiments. At least six different models of the Carden-Loyd machine have been produced to date, the principal changes being towards enlarged fighting compartments and improved running gear. The fourth model of this series was supplied with wheels for the road and tracks for cross-country going; had four ten-inch rubber tired track wheels on each side; and used rigid track suspension. Mechanical performance was fairly satisfactory, but the machine was unnecessarily rough riding. In the fifth model, an effort was made to relieve the jolting by mounting the track rollers in pairs on rocker arms. The latest model is considered an improvement over previous efforts, particularly with regard to track durability. Some of these machines, painted so as to be identified as representing light tanks, were assigned to medium tank battalions this summer to permit experiments with tank organization and tactics.



Carden Loyd with 3-inch Mortar. Normally Dismounted and Fired from the Ground.

The Vickers medium tank, though hot, noisy, and underpowered, is far superior to the best of the World War tanks. It carries machine guns mounted for simultaneous fire to the front and flanks, and a three-pounder cannon capable of all-around fire. An interesting feature of this machine is its air-cooled engine which was especially designed for tank use. It has proved to be less troublesome than the water-cooled motor; is immune to freezing; and has shown high efficiency in hot climates. The British are apparently well satisfied with the air-cooled type of engine, because they have now installed it in their latest armored tractor (dragon) for medium artillery, and are using air-cooled motors in their experimental tanks. Units equipped with these machines can march fifty miles a day for six days out of seven. It is estimated that about 250 of these machines have been built. They are now standard equipment for tank battalions, all World War machines having been discarded.

Caterpillar tracks for tanks have received constant attention, because the track is the least durable and most troublesome part of the machine. The demand for high speed has put track designers to the test. As with automobile tires, it is the pace that kills. The best tires that Major Seagrave could get for his famous "Golden Arrow" were guaranteed for only two minutes at the speed he required, though at ordinary speeds, the best commercial tires easily withstand 50,000 miles of wear. The riveted track plates used on the Vickers Medium Mark I were replaced with steel stamped plates on the Mark II. With these plates, the track pins and bushings had to be replaced after 1,000 miles, but the plates themselves were still in good condition. Further improvements have been made which give the track an estimated life of 3,000 miles at speeds between 12 and 18 miles an hour.

Three other endless tracks are worthy of note. The Jackson ball and socket track, first used on the Martel tanks, was designed to permit lateral motion of the track plates, so as to facilitate turning. Lubrication of the socket joints proved to be difficult and ineffective, and was finally eliminated altogether. Theoretically excellent, the Jackson track was a practical failure. A rubber jointed track has now made its appearance—no rubbing surfaces; no lubrication; some lateral flexion; noiseless; no appreciable stretch, hence no need for adjustment; fairly simple manufacture; fewer jolts than with the all metal tracks; 2,500 miles without maintenance and still in excellent condition. These excellent qualities are somewhat neutralized by the excessive weight of the track assembly. The Kegresse rubber and fabric track has passed through several test and development stages. Originally invented in Russia, it has been highly developed in France and extensively tested in England. The latest design has driving lugs spaced along each side of the endless fabric band, and rubber padded metal shoes. On hard roads, the metal shoes take much of the wear; on soft ground, the entire bearing surface makes contact and thus reduces the unit pressure. Advantages claimed for this track are:—good capacity to cross rough country, no joints, no lubrication, easy to replace worn lugs or shoes, no damage to roads, lighter and possibly less vulnerable than metal tracks, silent, permits higher speeds than do most metal tracks On a half track vehicle carrying 2,000 pounds and dragging a field gun, this track is said to have gone 2,500 miles without much deterioration. For similar duties, the French expect their latest Kegresse tracks to give 7,500 miles of service.. Al-

though the French are equipping some of their light tanks with Kegresse tracks, the British appear to have used the Kegresse on half track trucks only.

Two of the British experimental tanks of recent design, indicate the trend of development. The first of these, a Vickers machine weighing nearly thirty tons, was constructed in 1926-27. It carries four Vickers machine guns, one of which is mounted for antiaircraft fire; and one 3-pounder gun capable of all around fire. Maximum speed over twenty miles an hour; controls, hydraulic; engine, air-cooled, said to be the most powerful of its kind in existence, probably Diesel. The fighting compartment is separated from the engine room by a double bulkhead, and is ventilated by means of a fan. The driver is placed farther forward than in any previous model, so that he can see obstacles encountered in cross-country driving. Tanks of this weight are not regarded as suitable for normal assignment to a mechanized force; but as the need for their use may arise, it was considered advisable to build an up-to-date pilot model.

Carden Loyd with Trailer and .8-inch Antitank Gun. Quite a Train!

Satisfactory tests of this heavy machine were followed in 1928 by the construction of a 16-ton tank of similar design. The new medium machine is intended as the principal weapon for decisive action in a mechanized force. It has a sustained speed, on normal terrain, of 16 miles an hour; and is capable of making 32 miles an hour if pushed. Other characteristics are briefly as follows:—armor on vital parts proof against caliber .8 bullets, elsewhere .303-armor piercing bullets; ground clearance about 16 miles; well sprung suspension; no special protection against gas; equipped with radio phone; engine in rear, 180-horsepower air-cooled Armstrong-Siddeley. The crew consists of four men:—driver well forward; 1st gunner with an all-around-fire 3-pounder gun and a .303 Vickers machine gun mounted together; 2nd gunner with a pair of .303 Vickers machine guns; 3rd gunner with two .303 Vickers machine guns, of which one is mounted for antiaircraft defense. Though not so heavily armored as the French NC model 1927, this machine has more speed and more fire power than any other known tank of its size. It is so far superior to the present standard medium machines that Great Britain would no doubt be pleased to sell the older models to any prospective enemy.

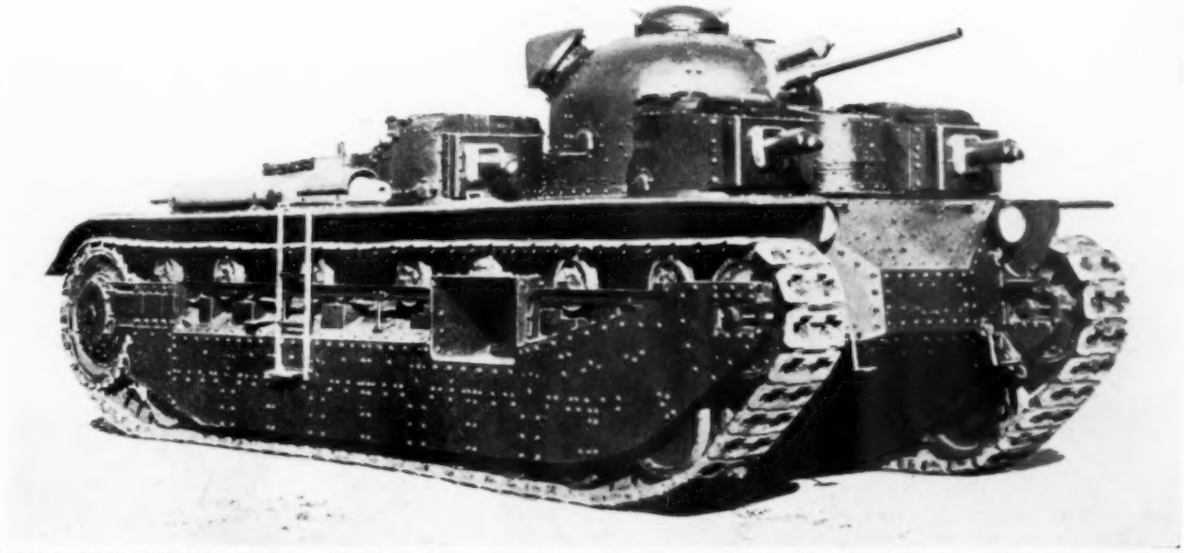
The Mechanized Force

The variety of machines contemplated for use in British mechanized forces is rather surprising. There is an evident tendency to create a special vehicle for each particular type of duty, though multiplicity of types means confusion in supply and operation. The caterpillar machines proposed include:—one and a half ton machines, like the Carden-Loyds and Morris-Martels, primarily for reconnaissance and for duty with the infantry; light tanks for reconnaissance and combat; medium tanks for decisive combat; artillery tanks for the close support of other fighting machines; special antiaircraft gun mounts; "dragons" for hauling medium artillery. Wheeled vehicles range from the 7 horsepower Austin scout car to the 13,500 pound Lanchester armored car, with 2, 4, or 6-wheel drive. In addition, there are many different types of trailers. The extent to which experiments have been carried has given rise to an assumption that many of the experimental types will be available for eventual use in quantities when permanent mechanized forces are organized. The British have purchased manufacturing rights on some promising foreign products, have borrowed progressive technical methods wherever they could be found, and have spent money liberally on numerous different experimental models. It has finally become apparent that the light tank is essential to the formation of a properly balanced mechanized force. An increasing number of British officers in the using services are becoming light tank enthusiasts; but this latest change in their desires has hardly had time to register on the drafting boards of the designers. When the British develop a good light tank, some of the present types will no doubt go into the discard, and with them will go much of the confusion from British thought on the composition of a mechanized force. Efficiency in a mechanized force as a whole demands simplicity in all things—the fewer the types of vehicles, the better.

A mechanized force, like the navy, must have well established bases, advanced depots, and efficient communications. Supply governs mobility. The force commander will naturally exploit the resources of the theater in which he operates, and by paying cash for what he needs, may be able to reduce his demands upon the normal supply agencies for food, oil, grease, and gasoline. However, he

must rely upon stores carried, those delivered by airplane, and the normal supply agencies for spare parts, ammunition, and other items that are not locally procurable. The proper organization and efficient operation of supply echelons is vitally important to a mechanized force, for unlike men and animals, machines must have full rations.

The old phrase, "fire and movement," takes on new significance in British mechanized tactics. The fighting machine



Heavy Tank of Recent Design. About 30 tons. Speed over 20 Miles an hour. Air-cooled Engine. Well Sprung Track Suspension. Driver Farther Forward than in Previous Models.

crews are protected by armor; they fire while moving and their movement often involves shock action. The fire power of the modern machines is formidable; the speed with which they charge increases the terror inspired by their power to crush. If the ground is too rough for accurate running fire, the machine can use shock action; or move to a more favorable area and renew the attack with better chances of success. Fire for destructive effect may be supplemented by the release of gas or smoke from containers in the machine. With comparative security, provided by speed and armor, the machine can employ a more effective combination of methods than is now possible with any other combat agency. The fighting machine has become the strongest "triple threat" member of the combat team.

The 1929 mechanization program, involving as it does the disbandment of the Armored Forces of 1926-27-28, is bitter medicine for those who labored to build up that force. They would prefer to maintain it intact, and develop it as a technical and tactical laboratory for future mechanized units. New forms of combat, with increased speed in all phases of the operations, should be worked out, so that the full powers of the new weapons can be utilized. These problems can be solved only in an actual mechanized force, like the one that was recently disbanded. There were and are many excellent reasons for the continuous maintenance of such a force. However, its maintenance involved heavy expense. The British authorities considered that the possibilities of available equipment had been amply demonstrated, and that new equipment would be required to justify further operations of a mechanized force. While the new machines are being built, the old ones will serve to carry mechanization ideas into the infantry and cavalry. To discontinue the Armored Force even for one training season means the sacrifice of much progress that has already been made; but the sacrifice will be well justified if it opens the way for changes in the organization, equipment, training, and tactics of infantry and cavalry.

CONTINUAL change is the principal feature of British mechanization. Rapid changes naturally result from experimental development work; but the cause of these changes—technical and scientific progress—is a continuing factor which will be increasingly potent. For thousands of years the battlefield mobility of combat troops has remained practically constant. Now comes the fast motor-driven fighting machine, and with it the certainty of drastic changes in the tactics of land warfare. Navies have improved their weapons and their mobility simultaneously; consequently, modern naval tactics have evolved gradually. If the navy had passed at one bound from wooden galleys to armored cruisers, what would have happened to wooden galley tactics? Centuries of tactical evolution would have been condensed into a decade of tactical revolution. A similar decade now confronts the army, and it will be a period of intense activity for officers who seek to keep abreast of the times. The cost of a fighting machine is small compared to that of a ship; and with the world's automotive resources at the disposal of military designers, technical development will be far more rapid than is possible in naval practice. Army commanders of the future will have their fleets of armored ships on the battlefield. The presence of fast fighting machines will modify the tactics of other combat elements; and as the machines are improved in mechanical design, their own tactical uses will change. If we may judge from naval experience, and from facts already established by British experiments, mechanization of ground troops in the army will act as an antidote for stagnant tradition.

Officials of the Philadelphia Post, Army Ordnance Association.

1. Philip H. Gadsden, President; 2. William C. Spruance, Vice-President; 3. Ernest T. Trigg, Vice-President; 4. Thomas S. Gates, Director; 5. Charles Day, Director; 6. J. W. Robbins, Director; 7. Charles Z. Tryon, Director. Mr. J. W. Rawle and Mr. J. L. Poultney also are members of the Board of Directors.

Who's Who in Industrial Preparedness

Officers and Directors of the Philadelphia Post, A. O. A.

WE PRESENT to the readers of ARMY ORDNANCE the following biographical sketches of some of the officers and directors of the Philadelphia Post, Army Ordnance Association:

PHILIP HENRY GADSDEN, President of the Philadelphia Post, was born in Charleston, South Carolina, October 4, 1867. He is the scion of a family famous in American history. General Christopher Gadsden, a well-known leader of the Revolutionary period, designed the famous rattlesnake flag, bearing the symbol "Don't tread on me," which was used by the Colonial troops prior to the adoption of the Stars and Stripes. Another of his ancestors was James Gadsden who negotiated the Gadsden Purchase with Mexico securing for the United States a tract of land now part of Arizona and New Mexico.

Mr. Gadsden received his education at Porter Military Academy in Charleston, and he then attended the University of South Carolina, from which he was graduated in 1888. In 1918 he received the degree of LL. D. from that University. Deciding to make law his profession, he studied and was admitted to the bar of South Carolina in 1890. Later he became a member of the law firm of Mordecai & Gadsden, and was actively engaged in the practice of law for 17 years, and also served six years in the South Carolina Legislature. In 1907 he retired from active practice of law to manage and direct local public utilities. He became president of the Charleston Consolidated Railway & Lighting Company, operating the railway, gas and electric properties at Charleston, and was also Vice-President of the Charleston Light & Water Company furnishing the water facilities in Charleston.

Within a few weeks after the declaration of the World War, Mr. Gadsden went to Washington where he remained during the entire period of the war. As chairman of the National Committee on Public Utility Conditions he represented the interests of the railway, gas and electric companies in the United States in connection with their war problems. He was a member, and subsequently chairman of the War Board of the American Electric Railway Association. It was the purpose of the organization of these two committees to coördinate the operations and facilities of the various public utilities for the purposes of the Government.

In 1918 he was made Vice-President of the United Gas Improvement Company of Philadelphia, in charge of its Department of Public Relations, which position he now holds.

Mr. Gadsden is President of the Philadelphia Chamber of Commerce, and a Director of the Pennsylvania State Chamber of Commerce. From 1921 to 1929 he was a Director of the United States Chamber of Commerce. He has also at various times in his career been President of the American Electric Railway Association, President of the Southern Gas Association, and President of the Eastern States Gas Conference. In 1919 he was appointed by President Wilson a member of the Federal Electric Railways Commission to investigate the serious condition of electric railways of the United States following the war. In 1929 Mr. Gadsden was elected President of the Philadelphia Post, Army Ordnance Association.

WILLIAM C. SPRUANCE, a Vice-President of the Philadelphia Post and also a Vice-President of the Army Ordnance Association, was born in Wilmington, Del., September 26, 1873, the son of Judge William C. Spruance and Maria Louisa (Spotswood). He was graduated from the Friends School, Wilmington, 1890, and from the Princeton University, 1894, E. E., 1895. Beginning as a shop student in the Pittsburgh plant of the Westinghouse Electric and Manufacturing Company in 1895, he became assistant engineer of the Wilmington City Electric Company 1896; manager, Cellulose Products Company, 1900. He practiced as a consulting engineer from 1901 to 1903. In the latter year he became light, heat and power engineer and assistant director of the high explosives operating department of the duPont Company, which offices he held until 1917. He served as an associate member of the Naval Consulting Board and a member of the Board of Directors of Organization for Industrial Preparedness, State of Delaware, 1916-1917.

Colonel Spruance was commissioned a major in the Ordnance Reserve Corps in December, 1917, and was promoted to lieutenant colonel, Ordnance Department, National Army, January, 1918, and colonel October, 1918. During his service in the Ordnance Department he was chief of the Explosives and Loading Division and a member of the Commodity Section on Explosives, War Industries Board, and of the Committee on Explosives Investigation of the National Research Council. He was honorably discharged from the Army February, 1919, and was awarded the Distinguished Service Medal, June, 1919. In May of the same year he became Vice-President, Director and Manager of the Executive Committee of E. I. duPont de Nemours & Co.

Colonel Spruance is a life member of the Princeton Engineering Association in which organization he served as Chairman of the Sub-Committee on Chemical Engineering 1919-1920, and member of the Executive Committee and Chairman of the Committee on Education 1921-23. He was the first member of the Army Ordnance Association to enroll for life membership, and is also the donor of the Spruance Endowment to foster an interest in industrial preparedness among the faculty and students of the Engineering School of Princeton University.

ERNEST T. TRIGG, a Vice-President of the Philadelphia Post, was born in Aurora, Ill., August 12, 1877, and was educated in the public schools of that city. Having served for many years as general sales manager of the Heath and Milligan Manufacturing Company of Chicago, manufacturers and distributors of paints and varnishes, he became, in 1908, general manager of John Lucas & Co., Philadelphia. Because of his untiring energy, ability and

loyal support of all movements tending toward the betterment of business policies and undertakings affecting city, state and federal government, his is an unusual career of public service. He served as President of the Philadelphia Chamber of Commerce 1917-1919, Regional Advisor, War Industries Board, Resources and Conversion Section; Director, War Welfare Council of Philadelphia; and member of the Central Committee of the Third Federal Reserve District, Liberty Loan Committee, 1918. He was appointed a member of President Wilson's Industrial Conference, representing employers, 1919; and a member of the Harding Unemployment Conference, 1921. In 1922 he became President of the National Paint, Oil and Varnish Association. Besides holding directorships in many financial and business enterprises, Mr. Trigg has been a trustee of Temple University since 1917, Director of the Chamber of Commerce of the United States since 1918, and member of the Chemical Advisory Committee of the Department of Commerce through appointment of then Secretary of Commerce, Hoover.

During the recent hearings on the bill for educational orders for munitions Mr. Trigg presented a very convincing statement on the advisability of educational orders, his testimony having appeared in the March-April, 1929, issue of ARMY ORDNANCE.

CHARLES DAY, Director of the Philadelphia Post and Chairman of the Board of Day & Zimmermann, Inc., was graduated from the Engineering Department of the University of Pennsylvania in 1899 with the degree of Bachelor of Science in Electrical Engineering and received the degree of Mechanical Engineer in 1903. The firm of Dodge and Day was formed in 1902, and shortly after the entry of John E. Zimmermann into the firm about 1907 the business was incorporated as Day & Zimmermann.

Mr. Day in his early professional life devoted himself almost exclusively to industrial problems bearing upon manufacturing efficiency. His intensive work in this field led to his recognition as an authority on industrial plants, and after many years of successful design and construction work by his firm he put in book form the important features of lectures which he had delivered at Lehigh, Columbia and Harvard Universities.

Shortly after the entry of America into the World War Mr. Day was made a member of the Storage Committee of the General Munitions Board, which Committee was continued under the War Industries Board. He was also appointed a member of the Depot Board by the Secretary of War. This board was instructed to inquire into storage and terminal facilities and conditions. In October, 1917, he was made a member of the Committee of Observation to report concerning conditions of shipyards. Later in the same month he accompanied the House Mission to England and France as engineering advisor to the Shipping Board representative. In this connection he made a study of the Allied shipping situation in relation to both military and civilian needs. Upon his return to this country he was made a member of the Army War Council and a trustee of the U. S. Shipping Board Emergency Fleet Corporation with a view to keeping the latter body fully informed concerning the War Department requirements. In July, 1918, he accompanied Mr. Edward R. Stettinius to France to secure information concerning port facilities.

Mr. Day is a trustee of the University of Pennsylvania, a member of the Board of Directors of the Fidelity Philadelphia Trust Company, of the Pennsylvania Railroad Company, and of the United Gas Improvement Company.

THOMAS S. GATES, Director of the Philadelphia Post, was born in Philadelphia March 21, 1873. He received his Ph. B. degree from the University of Pennsylvania 1893, LL. B., 1896, LL. D. Villa Nova College 1923, LL. D. Allegheny College 1928. He was admitted to the Pennsylvania Bar in 1896, and served as assistant in the law office of the late John G. Johnson of Philadelphia, 1895-1906. In 1906 he became Trust Officer of the Pennsylvania Company for Insurances on Lives and Granting Annuities, becoming Vice-President and Trust Officer in 1910. From 1912 to 1918 he served as President and Director of the Philadelphia Trust Company.

He became a partner of Drexel and Company in 1918 and of J. P. Morgan & Co., 1921. He is a director of many financial, public utility and business enterprises, and is a trustee of the University of Pennsylvania.

CHARLES Z. TRYON, Director of the Philadelphia Post, is President of the Edw. K. Tryon Company, whose employ he entered in 1888.

During the War Mr. Tryon was appointed a special representative of the Ordnance Department in charge of the civilian personnel section with offices in Philadelphia. He organized an office staff of men of affairs in Philadelphia who interviewed, during the year 1918, approximately 10,000 applicants for positions in the Government arsenals and in plants producing war material.

Mr. Tryon has always been interested in civic and welfare work, having served for a number of years as officer or director of many social welfare activities of his native city. He was one of the original committee which formed the Welfare Federation of Philadelphia and continues as one of the trustees of that institution.

J. W. ROBBINS, Director of the Philadelphia Post, is manager of the Motion Picture Department of Williams, Brown & Earle, Philadelphia. Having served in early life in the United States Navy, Mr. Robbins has always maintained an active interest in preparedness affairs and has always coöperated in the promotion to perfection of all military equipment.

Following the war Mr. Robbins became interested in aviation and spent approximately four years in commercial flying. He is an active member of the Army Ordnance Association and has taken a principal part in the activities of the Philadelphia Post.

California Post, A. O. A., Elects Officers

As a result of the balloting at the recent annual election of officers of the California Post, Army Ordnance Association, Mr. Pliny E. Holt and Col. C. N. Black were reelected president and vice president respectively. The following directors were reelected for a two-year term expiring November 30, 1931: Messrs. Bruce Cornwall, Theodore J. Hoover, Samuel Kahn and M. M. Mitchell. Mr. Mitchell, who is associated with the Pacific Telephone and Telegraph Co., Los Angeles, is an electrical engineer and succeeds Mr. Fred Boegle, Jr., on the directorate.

An Antiaircraft Battery in Action.

Our Eleventh Annual Meeting

Over 12,000 Witness Day and Night Ordnance Demonstrations

By L. A. Codd*

ON THE morning of October 10, 1929, the little town of Aberdeen, Maryland, presented an unusual sight. Through it sped a fast train bearing the Hon. Ramsay MacDonald, Premier of Great Britain, who, having concluded momentous conversations looking to the reduction of naval armaments for the greater security of international peace, was en route from the Capital to Philadelphia with his homeland his ultimate destination. Through the same village at almost the same hour came five special trains and automobiles to the number of 2,432 bringing members of the Army Ordnance Association and their guests, to the approximate number in all of some twelve thousand American citizens from north, east, south and west, to witness a program of technical and scientific military exhibitions and demonstrations the like of which has never before been viewed on American soil. The thousands were en route to observe munitions progress for the preservation of peace. The Premier and his entourage were upon a mission having the same ultimate end. The distinguished British visitor, with laudable sincerity, had come to America in quest of a common understanding on which to base the prevention of war. The thousands of American citizens with the same motive were come to Aberdeen to observe the effects of the machine age on our military defense against war. Both seek the same end—peace; both desire it through the same means—friendship; both loathe the day when international good will may give way to enmity—war, and both, we believe, are equally certain that should that good will ever be jeopardized either between themselves and their countrymen or themselves together and others, both are certain of the reliance that must be put upon "the sword"—now symbolic of an entire nation at arms—for the prevention of war and the guarantee of peace.

THUS it was that October 10, 1929, the occasion of the Eleventh Annual Meeting of the Army Ordnance Association at the Aberdeen Proving Ground, took on an unusual significance. The day was ideal—just such as Maryland in early October can and so regularly does offer to her native sons and visitors. The program of current ordnance tests was fascinating and instructive. The business meeting of the Association was the scene of inspiring addresses and enlightening technical discussions. The crowds were in fine fettle and departed at the end of a strenuous day more firmly convinced of the efficiency and complexity of our American weapons and of the need for industrial and professional coöperation with the Government in the production of munitions, should some one ever so far forget himself as to try to knock friendly peace and security into a cocked hat.

The program was opened promptly at 10:00 A. M. by Lieut. Col. E. M. Shinkle, Ord. Dept., U. S. A., Commanding Officer of the Proving Ground, who, in a fitting address, welcomed the guests to the reservation. At this point in our narrative time should be called to say a word

*Executive Secretary, Army Ordnance Association; Captain, Ordnance Reserve, U. S. Army.

Test Firing a 14-inch Gun on Railway Mount During the A. O. A. Meeting Program, Aberdeen, October 10, 1929.

of appreciation and congratulation to Colonel Shinkle, the officers and men under his command, and the civilian employees at the Proving Ground for a truly marvelous performance. It may be that in the normal course of events after ten years of such annual gatherings which yearly attract greater numbers, the kinks and wrinkles of procedure and the steps necessary for the smooth-running of so gigantic an enterprise would ultimately be ironed out. But no matter how often repeated and each repetition annually enlarged upon the staging of tests and demonstrations of ordnance for a full day and even into the night is an herculean task in itself. Add to this the handling of twelve thousand people, the traffic arrangements, the special trains from near and distant points, the meals and above all the safety precautions, as when, for instance, 4,000 lb. bombs are dropped or giant weapons hurling 2,000 lb. projectiles are fired. Under such conditions the guiding mind of so vast an enterprise and all those who contributed so valiantly and so efficiently to its successful operation are entitled to a world of praise and thanks. To mention by name everyone who assisted in the undertaking would entail the compilation of lengthy lists with the possibility always that some observer, for instance, who in his tower far down the range gave an O. K. when firing was about to commence, or an enlisted man whose job it was to see that no one was left stranded when the proving ground train departed for the next demonstration point, were not included. Rather let us felicitate Colonel Shinkle and in his person all and sundry both of the Ordnance Department and of the various branches of the Army who helped him so faithfully.

For ten years at our annual gatherings it has been customary to hold the morning program at the plate range. Regular visitors to the proving ground will remember that this point is—as they say in Maryland—a "considerable" distance from the Main Front and from a traffic standpoint has always meant some unpreventable delay and confusion. This year things were done differently. The entire morning program was held at the Main Front which necessitated no morning traffic movement in the proving ground whatever. A real improvement over the old order.

WHEN the first bugle call was sounded preliminary to the announcement of the first event, a count of noses revealed, in addition to the thousands of guests and, by the way, an even hundred newspaper representatives and photographers—still, movie and "talkie," a list of distinguished guests the roll of which will now be called:

Hon. Chas. F. Adams, Secretary of the Navy; Hon. P. J. Hurley, Assistant Secretary of War; Hon. Benedict Crowell, President, Army Ordnance Association, Assistant Secretary of War in Cabinet of President Wilson, and Director of Munitions during the World War; Hon. Hiram Bingham, U. S. Senator from Connecticut, President, National Aeronautic Association; Hon. David A. Reed, U. S. Senator from Pennsylvania; Hon. David S. Ingalls, Assistant Secretary of Navy for Aeronautics; Maj. Gen. C. C. Williams, Chief of Ordnance, U. S. Army, since April, 1918; Brig. Gens. C. L'H. Ruggles and Samuel Hof, Assistants to the Chief of Ordnance; Col. E. D. Bricker, Chief, Technical Staff, Ordnance Department; Brig. Gen. Edw. L. King, Assistant Chief of Staff, G-3; Brig. Gen. Ewing E. Booth, Assistant Chief of Staff, G-4; Brig. Gen. Geo. V. H. Moseley, in charge of industrial mobilization, Office of the Assistant Secretary of War; Maj. Gen. Fred T. Austin, Chief of Field Artillery; Maj. Gen. Andrew Hero, Chief of Coast Artillery; Maj. Gen. Stephen O. Fuqua, Chief of Infantry; Maj. Gen. J. E. Fechét, Chief of Air Corps; Brig. Gen. F. LeJ. Parker, Chief, Bureau of Insular Affairs; Col. E. R. Redmond, Acting Chief, Militia Bureau; Maj. Gen. Harry L. Gilchrist, Chief, Chemical Warfare Service; Adm. Charles F. Hughes, Chief of Naval Operations; Rear Adm. Wm. A. Moffett, Chief, Bureau of Aeronautics, Navy Department; Rear Adm. Wm. D. Leahy, Chief, Bureau of Ordnance, Navy Department; Rear Adm. S. S. Robison, Supt., U. S. Naval Academy; Rear Adm.

A. L. Willard, Commandant, Naval Gun Factory, Washington, D. C.; Col. Wm. C. Spruance of Wilmington, Del., Vice-President, Army Ordnance Association; Gen. John Ross Delafield of New York, N. Y., Counsel, Army Ordnance Association; Col. C. L. Harrison, of Cincinnati, Ohio, Director, Army Ordnance Association; Mr. Harold C. Smith of Chicago, Ill., President, National Metal Trades Association; Mr. J. G. Benedict, Vice-President, National Metal Trades Association; Mr. Homer D. Sayre of Chicago, Ill., Commissioner, National Metal Trades Association; Mr. J. E. Nyhan of Chicago, Ill., National Secretary, National Metal Trades Association; Dr. Chas. L. Parsons of Washington, D. C., Secretary, American Chemical Society; Lt. Col. L. H. Whiting and Col. F. S. Dickinson, members of the War Department Business Council; Maj. C. F. Morley, Mr. Geo. C. Brainard and Mr. W. R. Tyson, of the Ammunition Advisory Board.

Lieut. Col. E. M. Shinkle, Ord. Dept., U. S. A., Commanding Officer, Aberdeen Proving Ground.

AT 10:05 on the Main Front a demonstration of small arms matériel was given. This included firing with tracer ammunition of the water-cooled Cal. .30 Browning machine gun, Cal. .50 Model 1921, antiaircraft machine gun, and the 37-mm. automatic cannon. The artillery ammunition firings which followed included the 75-mm. gun, Model 1897, with black, smokeless and flashless powder, demonstrating the progress made in the development of flashless powder which is not subject to the effects of atmosphere. The same model gun was used also to show the form of projectile by firing a series of rounds of shrapnel with time fuzes set at two-second intervals to function simultaneously.

The next group included demonstrations of mobile artillery matériel beginning with the 37-mm. gun M 2 and carriage M 1, a late post war development of infantry accompanying gun now adopted as standard. This weapon fires a projectile weighing 1.25 lbs. with muzzle velocity of 2,000 f. s. It may be fired from wheels or from a bipod when the wheels are removed. One of the latest developments in infantry weapons designed for use against tanks, machine gun nests and strong points was shown in the 75-mm. infantry mortar, smooth bore with fin-type projectile, Model 1922 E, fired through coils of the solenoid chronograph. This weapon is so designed as to be disassembled readily into loads which can be transported by hand. Other demonstrations in the same group included the 75-mm. gun M 1 and carriage M 1, a development of the divisional weapon firing a 15-lb. projectile with a range of 15,000 yds. at 45° elevation; the 105-mm. howitzer T 2, a post-war development of divisional howitzer of the split-trail type with range of 12,000 yds., with a 33-lb. projectile; the 155-mm. howitzer T 1 with maximum range of 16,000 yds., using a 95-lb. projectile, and the 155-mm. gun, 8-inch howitzer motor carriage, Mark IX, Model 1921. The latter weapon is a post-war development of a self-propelled carriage designed to mount either a 155-mm. gun or an 8-inch howitzer for army artillery. The carriage has attained a maximum speed of 10 miles per hour. The group of artillery ammunition demonstrations was concluded with ballistic firings showing the methods used in

Inspecting an Antiaircraft Gun at the Meeting.

Left to right: Hon. R. P. Lamont, Secretary of Commerce; Hon. Patrick J. Hurley, The Assistant Secretary of War, and Hon. Benedict Crowell, President, Army Ordnance Association.

Some of the Visitors at Aberdeen Proving Ground for the A. O. A. Meeting.

determining the resistance due to the air and its effect on the flight of projectiles as well as the stability of projectiles in flight. The course of the shell is determined by firings through series of cardboards. Velocities are taken at different intervals.

AT 10:40 a demonstration of equipment of a mechanized force was given. The purpose of the display was to show the movements of an improvised force which, due to lack of equipment and limited space, could not illustrate tactical principles. This consisted of an advance guard comprising an armored command car and Christie light tank, and was followed by an echelon of two light tanks and a track development chassis employed as an infantry carrier to brush aside resistance developed by the advance guard. Next came a second echelon of a platoon of 6-ton tanks aimed to overcome increasing resistance and was followed by a third echelon consisting of two medium tanks and one heavy tank to provide additional fire and crushing power. Occupation of position and opening of fire was then demonstrated by two mechanized batteries of the Sixth Field Artillery from Ft. Hoyle, Md. The next element consisted of an echelon of cross-country cars and cargo carriers bringing forward infantry with automatic rifles and machine guns to hold positions taken by the tanks. The concluding element was the advance of a war strength platoon of infantry supported by 75-mm. guns on self-propelled mounts and accompanied by a chemical warfare detachment with 4.2-inch chemical mortars.

The afternoon portion of the program began at the Administration Building at 1:00, where the annual business meeting of the Army Ordnance Association was held. Hon. Benedict Crowell, President of the Association, presided. Mr. Crowell addressed the gathering on the aims and purposes of the Association, other speakers on the program being Hon. Hiram Bingham, President of the National Aeronautic Association, Maj. Gen. C. C. Williams, Chief of Ordnance, U. S. Army, and Mr. Harold C. Smith, President of the National Metal Trades Association. A verbatim transcript of the proceedings and the addresses delivered is given in the following pages.

Following the business session the Main Front and the Museum were open to visitors for the inspection of World War artillery, automotive and chemical warfare matériel.

THE demonstration by the Army Air Corps began at 1:50 on the Main Front. The planes with personnel taking part consisted of a flight of bombardment planes from Langley Field, Hampton, Va., and a flight of pursuit planes from Selfridge Field, Mt. Clemens, Mich. The demonstrations included an attack of targets by pursuit planes using machine guns; demonstrations of formation flying, aerobatic flying and individual combat by pursuit planes. These were followed by an attack of ground targets by a flight of bombardment planes from which 300-lb. demolition bombs were dropped to illustrate the attack of a ground target by a formation of this type of craft, and a 4,000-lb. demolition bomb set for instantaneous action was also dropped. This bomb is the largest yet developed and contains one ton of high explosive. It is intended for the attack of objectives requiring a powerful concentrated blow.

At 2:50 the antiaircraft day firings were begun on the Antiaircraft Range by the 61st Coast Artillery (A. A.) Regiment from Fort Monroe, Va., using latest types of antiaircraft matériel against sleeve targets towed by airplanes.

Among the larger types of weapons for seacoast defense the 14-inch gun, Model 1920, MII, on railway mount and the 16-inch gun on barbette carriage, Model 1919 MII, were fired.

Following supper visitors were taken to the Antiaircraft Range where night firing was conducted with the same weapons and by the same personnel which had participated in the day firings. Additional equipment used included signals for ground illumination and for landing lights and latest types of searchlights and sound locators.

AND so, under a cloudless sky with the harvest moon in the heavens where the sun had been when the program started, the thousands departed. Premier MacDonald by that time was the guest of admirers in New York telling them of his hopes and aspirations for the suppression of war and of the unanimous similar desire of his countrymen. When he arrives home he will tell his compatriots of the general desire in America, so synonymous with his own, for peace. And he will know that there were twelve thousand odd at Aberdeen, October 10th, who are with him and his efforts heart and soul. They too want peace, and they intend to have it.

Progress of Munitions Preparedness

Proceedings at Eleventh Annual Meeting, A. O. A.

THE proceedings at the Eleventh Annual Meeting of the Army Ordnance Association at the Aberdeen Proving Ground, Thursday, October 10, 1929, were as follows:

The meeting was called to order at 1:15 P. M. by Hon. Benedict Crowell, President of the Association.

MR. CROWELL: "Members of the Army Ordnance Association and Guests:

"It is always a pleasure for me, as President of the Army Ordnance Association, to have the opportunity which our annual meeting presents to address you. This is the one occasion of the year when I can tell you directly of the status of the Association and the progress of its work. This I propose to do briefly and I also desire to restate the aims and purposes of our organization which, at this time, seems particularly appropriate.

"As to the affairs of the Association, I am happy to say that they are in the best condition of our eleven years' existence. Our membership of 3429 is the largest we have ever had, our financial situation continues as sound and healthy as it has been in recent years, and our national and local activities for industrial preparedness continue to enlist the interest and coöperation of our members throughout the country. Our local posts, which now exist in 10 industrial centers, are doing excellent work. I will not burden you with details of operation other than to say that they are satisfactory and are being conducted in accordance with our aims and purposes as stipulated in our Constitution and By-laws.

"In view of the far-reaching international negotiations now being conducted looking to the continuance of peace through the outlawry of war and the limitation of naval armament, I think it fitting that we restate the objectives of our organization. Peace is wanted by us all; our people are unanimously for any plan which will guarantee it. Consequently it may seem incongruous that we are gathered here to observe the progress of our munitions developments, to witness the test of the most deadly and destructive military implements thus far devised. It may seem contradictory that, while we individually and as a body wish entire success to the present international negotiations for lasting peace, we continue to interest ourselves in the machines of war.

"BUT, in the final analysis, there is nothing incongruous, nothing contradictory about it. We of the Army Ordnance Association are for peace first and last. Indeed I sometimes feel that we are more strongly for peace than a great many people who are out and out pacifists. We do not favor huge, threatening armaments. We are not militarists. We are not war-lords. But we believe that until humanity is made over, until jails and prisons are erased from our daily life, until the policeman has disappeared from our streets, there will be the necessity for adequate preparedness against war. Until peace negotiations have proved themselves as lasting as the history of man has proved resort to arms to be a fact, we believe that reasonable preparedness is one of the most assuring guarantees of peace. Consequently, while hoping for the success of all measures looking toward continued international peace, we reaffirm the purposes of our Association. I cannot state them more succinctly than they appear on the program of which you have copies.

" 'The Association is purely patriotic; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims.

" 'The Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency, time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

" 'The Army Ordnance Association believes that the solution of this problem, based on experience, lies in an active organization at all times coöperating with the Government. The principal objective of the Association is an active membership of American citizens, on whom the duty of design and production of munitions will fall in war, who will have an accurate and authentic knowledge of the complex requirements of ordnance. "Peace Insurance" in this form is the foremost aim of the Army Ordnance Association.' "

"I now take pleasure in presenting to you Senator Hiram Bingham of Connecticut, President of the National Aeronautic Association. Few men have done more for aeronautics in this country than Senator Bingham. He is an educator and explorer of note and has an eminent record of military service in the World War. Senator Bingham."

SENATOR BINGHAM: "Mr. President, Members of the Army Ordnance Association, and Guests, on behalf of the National Aeronautic Association, of which I have the honor to be President, I desire to express to you our appreciation of your very great kindness in inviting us to be your guests today at this annual meeting of yours.

"The National Aeronautic Association, founded some seven or eight years ago by a group of those interested in aviation, felt that there should be a national association devoted to the motto of 'Seeing America First and Having America First in the Air,' has taken over the duties of being the American agent of the great International Federated Aeronautic Association, has charge of all records and all races, and looks after aeronautics as a sport and as an agent by seeing that the records may be properly authenticated, and that those who take part are protected. Its interest is in the pilots as well as in the planes.

"Like your own Association, it is not for profit, in fact it has never yet been out of the 'red,' and its friends have

had to come to its relief every year in order to keep it going, because it has so many more things to do than it can possibly find means to do them with. A part of its activities are in connection with commercial aviation and its various functions, but one of the most important parts of its program is backing up national defense. In its policy is a cordial and hearty support of the five-year program laid down for the Army and Navy by the Congress in 1926. Like yourselves, it is interested in the national defense. Like your Association it believes in the dictum laid, down by our own Washington—'In time of peace, prepare for war.' We would stand only to lose if war came, and we, like you, believe there is always a danger after a great war that the interest in national defense will diminish and the public will turn its attention to commerce, and business, and the enjoyment of comfort and luxuries, and making of money, and begrudge the money in order to be prepared for any emergencies.

"It has always been the history of countries ruled by the people that when war comes these countries have never been ready; they have been slow in coming into conflict; they have always tended to go backward in the national defense and not to keep up the highest standards. It is difficult for the great mass of the people engaged in commerce to realize the necessity for the national defense. So the National Aeronautic Association congratulates you on the splendid record from year to year you have made in these meetings in keeping alive our interest in the science in which you are interested.

"Aviation, of course, needs your aid. Our chief method of striking at an enemy, in which we can do the most damage to warships that would attack our coast, is through bombs that are constructed by Ordnance officers and under ordnance guidance. If those bombs fail to work, then the lives of the pilots are necessarily endangered. They may risk their lives in the air only to find the bombs dropped fail to perform their function. All their activities and efforts would be wasted only to find that the bombs dropped by the bombing squadrons failed. It is just as important that the bombs should be as perfect as it is possible to make them as it is that the planes be made equally perfect.

"Your antiaircraft batteries were sometimes smiled upon by pilots, especially pursuit pilots, during the war, who were not much worried because they actually had an elevation which the guns of those days failed to reach. On the other hand bombing pilots that were engaged felt very keenly the antiaircraft firing. If the ceiling happened to be low, they knew to go out on their missions meant loss of life. In fact, the bombing squadrons on the front, in the course of a day, would lose 50 per cent of their pilots, due to antiaircraft fire. It is interesting to know that your progress in antiaircraft defense has gone forward much faster than anyone might have reason to expect. Just as the great seacoast defense guns are necessary in connection with the Navy, in case an enemy gets by, or obstructs the Navy, only to find the seacoast guns ready for it, so it must always be in aviation. Enemy planes must know that they are going to receive a warm reception at the critical points.

"I am not one of those who do not believe in antiaircraft. I realize only too well that the pilots of bombardment squadrons are going to be very chary of attacking points where there are antiaircraft guns. The work which you have done in perfecting this weapon in national defense should be one for which all of us should be grateful.

"I know your program has been delayed and I will not trespass upon your time, nor take upon myself the privilege of a Senator to speak without limit of time due to our practice of not having a limit. I want to tell you how greatly we appreciate being your guests today, and to tell you that in all things the National Aeronautic Association wishes you success in promoting the joint cause for national defense."

Mr. Crowell: "In presenting the next speaker I have no hesitancy in introducing him as the greatest Chief of Ordnance in the history of our country, Maj. Gen. C. C. Williams. He was among the group of officers selected by General Pershing as the advance guard of the American Expeditionary Forces in the World War. He served as Chief Ordnance Officer overseas under General Pershing and was later designated by him to return to this country to become Chief of Ordnance in April 1918. I have often thought that it must have been a great sacrifice for him to assume his arduous task. His great record for American munitions during the World War is well known to you. His continuous service as Chief of Ordnance since that time has resulted in the great progress you are witnessing here today. When aircraft became a formidable element in warfare he personally directed the design, development and manufacture of our bombs, the largest of which you will see dropped this afternoon. After arming aircraft and thus making it a new and vital element of our defense, he turned his energies to development of antiaircraft artillery which is the greatest stride in the development of gunnery in all history. An executive and engineer of the first order, General Williams, our Chief of Ordnance, is entitled to the praise and gratitude of us all."

General Williams: "Immediately following the signing of the Armistice on November 11, 1918, a board of officers was appointed in the American Expeditionary Forces to study the types and uses of artillery in modern warfare and to make recommendations for the future guidance of the United States in the development of artillery. As a result of the report of this board, the Ordnance Department has undertaken the redesign and improvement in practically every class of mobile artillery.

"In the outline of this development to follow, mobile artillery has been subdivided into the following classes: (a) Infantry accompanying artillery; (b) divisional artillery; (c) corps artillery; (d) army artillery; (e) pack artillery, and (f) sighting or fire-control equipment. Each of these subdivisions will be briefly considered in turn.

"The need of weapons to accompany infantry with a greater fire power than the rifle and machine gun was made apparent during the World War. The resistance to infantry advance of past wars was augmented by the use of concrete emplacements for machine guns, tanks and armored cars upon which the small arms weapons had little or no effect. The demand for more powerful weapons was therefore soon recognized with the result that there came into existence the smaller calibers of artillery, such as the 37-mm. gun, 3-inch Stokes mortar, etc.

"After the World War this problem was given considerable study resulting in the design, construction and test of sizes and types ranging from the 37-mm. to the 3-inch, with the result that the following have been finally adopted as standard for this equipment: 37-mm. gun, M1, and 75-mm. infantry mortar, M1.

"The 37-mm. gun M1 is a weapon of extreme mobility which can be transported and fired on its own wheels or broken down into loads which can be man carried and assembled to fire on a tripod arrangement without the wheels. It has a range of approximately 6,000 yards, firing a projectile which weighs approximately 1.25 lbs.

"When compared with the 37-mm. gun, Model 1916, used as a standard in the World War, the new gun is of the same weight, same mobility and same ease of manipulation as the 1916 model but has in addition an increase of approximately 225 per cent in muzzle energy, 35 per cent in range and 50 per cent more armor penetration at 500 yards than the old gun.

"The 75-mm. infantry mortar M1 is a high-angle fire weapon designed primarily to replace the 3-inch Stokes trench mortar. It is a wheeled mount, extremely mobile, with a maximum range of 1,800 yards and fires a projectile weighing 12.18 lbs. It can also be disassembled into loads which can be carried over difficult terrain by men.

"The 75-mm. mortar when compared with the 3-inch Stokes mortar used by the infantry in the World War is found to have 50 per cent greater muzzle energy, approximately 150 per cent greater range, is more accurate and fires a shell which has superior fragmentation characteristics to that of the 3-inch Stokes mortar.

"To accompany these weapons and the machine gun there has been designed, built and tested a succession of vehicles, ranging from an infantry caisson and limber to the finally adopted infantry cart M2. This cart is a two-wheel cart with a standard chassis upon which is mounted a body of types suitable to use with the machine gun, the 37-mm. gun, or 75-mm. infantry mortar or for the transportation of ammunition or equipment for these weapons.

"THE standard weapon used by the U. S. Army for divisional or light field artillery during the World War was the French 75-mm. Model 1897 M1. This weapon has a range of 9,000 yards with an elevation of — 10° to + 19°, traverse of 6° and weighs 2,657 pounds in firing position.

"In 1919 the Ordnance Department actively assisted by experienced officers of the Field Artillery prepared specifications for a new divisional weapon and, based upon these, work was started on the design and construction of a pilot.

"As a result of tests of a number of split-trail and box-trail types a satisfactory unit was produced and standardized as the 75-mm. gun M1. Compared with the 1897 the new M1 has 65 per cent more range, an elevation from — 5.6° to + 45°, as against — 10° to + 19° for the old type, a traverse of 42.5° against 6°, and weighs but 458 pounds more than the old weapon.

"The split-trail type of carriage proved so satisfactory for the 75-mm. that it was decided to experiment with this type for the 105-mm. divisional howitzer. This type carriage, now known as the M1, has an elevation from — 5° to + 65°, traverse of 45°, a range of 11,960 yards and weighs 3,750 lbs. in firing position. This is an entirely new caliber and type for our service and is considered far superior to any similar caliber used by other armies during the World War.

"DEVELOPMENT of the 4.7-inch gun has been suspended during the year because of the belief that the newly developed 155-mm. howitzer would meet all corps artillery requirements thus permitting the elimination of one caliber i.e., the 4.7-inch gun. Two of these new 155-mm. howitzer units are now ready for test. They are mounted on a split-trail carriage and have the following characteristics: Maximum elevation 65°, traverse 58°, and range 16,400 yards with a weight limbered of about 9 tons. This howitzer while somewhat heavier than the 4.7-inch gun is not too heavy for use by the corps artillery and its projectile weighs 95 lbs. as compared with 45 lbs. for the gun.

"SINCE the World War the Ordnance Department has designed and built one army carriage, M 1920, intended to mount either a 155-mm. gun or an 8-inch howitzer. A wagon for transporting the cannon is included in the equipment.

"A redesign of this matériel has been undertaken and has progressed to the point where a wooden model has been constructed. This new matériel, known as T1, differs from the M 1920 matériel as follows: (a) larger wheels, (b) increased ground clearance, (c) elimination of pit to clear cannon recoil, (d) built-up cradle and sleigh instead of single forging, (e) extended cradle, (f) equilibrators relocated, (g) elevating mechanism redesigned (spur gear and band brake), (h) welded trail, (i) spades redesigned, (j) transport wagon completely redesigned, (k) equilization of road weights of carriage and transport wagon, and (l) increased stability.

"The manufacture of a new pilot carriage has been ordered. When mounting the 155-mm. gun we will secure an increase of about 9,000 yards in range over the 155-mm. G. P. F. while with the 8-inch howitzer we get about 19,000 yards range as compared to about 12,000 yards for the war type.

"THE new pack artillery which has been developed since World War continues to prove highly satisfactory in service, but except for one battery the pack units of the Regular Army are still equipped with the 2.95-inch gun M 1896. This weapon is obsolete and practically all on hand are also unserviceable. The 75-mm. pack howitzer M1 has the following general characteristics: range, 9,000 yards, elevation 45°, weight in firing position 1,268 lbs., transportable on its own wheels by one animal, or disassembled it may be packed on six mules. The fire efficiency of this howitzer is comparable to that of the 75-mm gun, M 1897.

"THE intensive program for development of antiaircraft artillery equipment, inaugurated in 1925, has been continued during the last year. The 1928 antiaircraft exercises produced several important results, particularly the standardization of the 3-inch mobile carriage and the definite adoption of the indirect, or the so-called Case III, method of fire control, wherein the antiaircraft director, height finder and automatic transmission between the ele-

ments of the fire-control system and the guns are utilized. An important corollary of this policy is the elimination of all sighting apparatus from antiaircraft gun carriages. A brief resume of work accomplished on the most important development projects during the last year, may be of interest to you.

"The Ordnance Department director was given a short test during the last antiaircraft exercises. The test demonstrated that while the principles employed were probably superior to any other similar purpose instruments of which the department has knowledge, a number of mechanical defects existed which seriously detracted from its performance. The director has now been modified and is now under test. Pending the completion of this development the Ordnance Department has ordered a number of directors from the Vickers Company in England.

"A number of height finders, procured in this country and abroad have been tested. These instruments fall in two general classes, the stereoscopic and the coincidence. The height finders procured from foreign sources include the latest types supplied as standard equipment for the antiaircraft organizations in the principal European countries. The tests have demonstrated that the stereoscopic is superior in principle to the coincidence for antiaircraft work, and further that the standard length of base of 4-meters is insufficient to give the accuracy desired. It is now proposed to experiment with 6-meter base height finders in an effort to secure greater accuracy, at the same time restricting the weight and size sufficiently to keep the instrument readily portable and suitable for field use.

"The antiaircraft sound locator development has been completed and a satisfactory type adopted for future manufacture and issue. This newly standardized type is permanently mounted on a pneumatic-tired trailer which is towed by the searchlight truck. The sound locator horns will determine the position of the approaching airplane with surprising accuracy at ranges beyond those given by the most powerful searchlights. An acoustic corrector is provided to correct the direction given by the horns for sound lag and ballistic conditions effecting the movement of the sound waves through the atmosphere.

"Limited production of 3-inch antiaircraft mobile guns has been started during the current year. This type continues to prove highly satisfactory in service and is so far superior to the war-time equipment with which our regiments are now armed that early production of the new matériel sufficient in quantity to equip the Regular Army and National Guard and to provide a reasonable reserve is essential.

"In response to the requirements of the Coast Artillery Corps, the Ordnance Department has undertaken the design of a caliber .50 multiple machine gun mount, which with its fire control will be permanently mounted on a large six-wheel truck. As this mount is intended primarily for the defense of marching columns and transport, it is essential that it be capable of going into action immediately without any delay incident to levelling, orientation, or determination of firing data. This represents a radical departure from our previous methods and introduces many new and interesting features of construction. One mount has been ordered and is expected to be completed in time for the current antiaircraft exercises.

"At present we have two essentially different types of artillery with an army, one designed to fire only at targets on the ground, the other designed to fire primarily at targets in the air, but also capable of effective fire against ground targets. This is uneconomical and unsound from the military viewpoint. A commander should be able to use all his guns at any time against any part of the enemy force whether on land or in the air, and the importance of this requirement increases with the increasing effectiveness of the airplane as a combat machine. A new carriage for the 75-mm. 2175 f. s. field gun has been designed and is under manufacture. It is of the pedestal type and will permit 85° elevation, 360° traverse and a rate of fire of about 20 rounds per gun per minute. It is believed that this gun and carriage will perform all of the functions of the present 75-mm. field gun and that at the same time it will, when provided with proper fire control, give satisfactory defense of the advanced sections of the combat zone against aircraft.

"ABOUT six months ago the Watertown Arsenal undertook a comprehensive study and practical application of improved methods of welding in the construction of Ordnance matériel. It was appreciated at the beginning that the use of haphazard methods of welding and poorly defined technique would, in view of the high character of workmanship required in ordnance construction, possibly prejudice extended application of welding and it would be necessary at once to obtain information as to the most modern types of equipment and welding technique.

"The works of the General Electric Company, the Westinghouse Company, and the A. O. Smith Corporation, all of which have made great advances in welding processes within the last few years, and all of which apply these processes largely in construction, were visited. These visits were subsequently followed by visits to the Ford Motor Company, the Metropolitan Engineering Company and several of the works of the General Electric Company.

"After preliminary investigation of technique and equipment available, the new welding equipment was installed of such types that it is now possible to carry out practically any form of hand and automatic electric arc welding. The installation is of such capacity that ten welders could be employed continuously on hand and automatic arc welding, including welding by the atomic hydrogen process and welding with the hydrogen sheathed arc. Equipment previously on hand, although not of the most modern type, was set up for resistance butt welding and spot welding.

"Good welding is very largely a metallurgical problem and the laboratory has been utilized extensively in the investigation of the structure of welds and in the examination of welds by X-ray. While information on the characteristics of welds of all types and the technique of welding was sought from authorities on welding, from publications on the subject and in literature of the American Welding Society, it was very early obvious that it would be necessary to obtain a great amount of first hand information and for this reason a number of experimental programs were laid down. These included examination in the physical laboratory by the X-ray and by macro-etching of numerous experimental welds made on carbon and structural nickel plate. These plate materials were also welded with

several types of the best known feed wires of various compositions, both fluxed and unfluxed. Each of these experimental welds was also given several different anneals in order to determine under which specific combination the best weld was obtained. Welded joints of various characteristics have also been subjected to fatigue tests. Comparisons have been made between welds made by hand, by the automatic head and by the atomic hydrogen method under various combinations of conditions.

"THE above indicates only very briefly the general character of experimental work conducted. Contemporaneously with these experimental programs, a number of important practical applications have been made in shop work. The top carriage for the 3-inch antiaircraft gun is a rather difficult casting and it was found impracticable to obtain these without numerous shrinkage cracks and other defects. One of these top carriages was built up of soft carbon plate welded throughout and subjected to laboratory test under which it withstood without permanent set a load of five times as great as under service conditions, with the result that subsequent top carriages are now being made of material one-half the thickness of that prescribed in the casting. Material has now been procured to manufacture the pedestal casting for this same gun carriage which also gave trouble in procurement. A large variety of less important parts of carriages now in construction are being welded instead of riveted. It was also found possible to manufacture a number of jigs used in the shops by building these up of structural plate welded. These jigs were required promptly and it was found that it would be much quicker to build them from scrap material already available than to undertake manufacture of patterns and procurement of castings with considerable uncertainty in delivery.

"It has become quite obvious that a very large percentage of cast and riveted components entering into artillery material can be made to advantage by using structural plate welded. Plate can be procured in quantity at two to three cents per pound while castings will cost from ten to sixteen cents, on the average. When building in small quantity, pattern construction is relatively very expensive and the Watertown Arsenal has, in addition, experienced extended delay in the delivery of castings followed by repeated rejections. It is not possible to generalize and state that welded construction is cheaper than casting or riveting, and each case must be considered on its own merits. The indications are, however, that after correct procedure has been established and the work systematized, welded construction will in general be cheaper and apparently more reliable than castings, which are always of uncertain quality. At the present time, we are constructing a large frame for a centrifugal casting machine which is made of plate from one to two inches in thickness, weighing in all about 15 tons. This machine is being fabricated entirely by welding and while costs are not available, it is believed welded fabrication of the frame of this machine, prior to machining, will not greatly exceed the cost of the pattern, while the material itself is costing certainly less than one-half that of the iron casting.

"On the whole, it is believed that with careful procedure and installation of proper equipment, the selection and training of personnel, the provision of facilities for necessary X-ray and metallurgical examination and data on technique, all subject to competent control, welded construction will play a more and more important part in the fabrication of ordnance material and in numerous applications which have not been referred to above, such, for example, as fabrication of shell bodies by resistance welding and bombs used by aircraft.

"There is now a marked trend toward greater use of welding in industrial work and the Ordnance Department can undoubtedly greatly improve much of its construction in this manner. Especially in all new design work, fabrication by welding should be always considered. In war, material will be available almost immediately and the time now lost in making patterns and castings largely recovered.

"The forgings for guns manufactured during the past year have all been cold worked. One hundred and sixty-five forgings have now been produced by this method and not one has failed in service. The Watertown Arsenal has continued to make minor improvements in the process and equipment, but the process is now standardized and is highly satisfactory.

"THE experimental work on centrifugal casting of guns has continued during the past year with increasingly promising results. It is believed that the process has been satisfactorily established for the 37-mm. gun, the 75-mm. infantry mortar and the 75-mm. pack howitzer.

"A larger casting machine for production of the 75-mm. field gun, the 105-mm. howitzer and the 3-inch antiaircraft gun is under construction and soon will be in operation. The successful completion of this work is highly desirable because of the probable decrease in cost and time of production which would result.

"Approximately three mobile guns can be cast from the amount of molten metal that has heretofore been required for one built-up gun made from forgings. It is estimated that a gun can be cast and cold worked in approximately one-third the time and at about one-half the cost of built-up guns forged from ingots.

"The physical properties obtained from centrifugal castings after treatment are better than obtained from forgings of the same composition. The metal generally is exceedingly ductile and in this respect appears to be superior to that of forgings of the same composition.

"Another feature of interest and of great importance is the segregation of the elements, especially carbon, brought about by centrifugal force. Not only slag and other nonmetallic inclusions are forced to the bore before and during solidification, thus cleansing the metal, but also the carbon is thrown toward the center in a gradual change so that, for example, in the 75-mm. pack howitzer the carbon may be 20 to 25 points higher at the bore than at the outside. This gives greater strength at the bore where high elastic limit is needed and a correspondingly ductile outside wall. Segregations of other elements, although not so pronounced, behave generally like the carbon.

"DURING the past year development has proceeded in connection with the light tank. Four tanks, known as the model T1 E1, have continued their test both here at the proving ground and at the Tank Board at Fort George

G. Meade, Md. A model, known as the Light Tank T1 E2, has been constructed incorporating various mechanical changes found advisable as a result of test, and a somewhat modified compartment for the driver and gunner of the vehicle. This tank has completed its shop test and will shortly arrive at the proving ground for mechanical test. It will then be shipped to the Tank Board for further operation. It is hoped to construct six or seven more of these vehicles during the present year so that a sufficient number may be available to conduct tactical operations for the training of personnel in the use of these high-speed vehicles. The role of tanks by reason of their increased speed and fire power is very much enlarged over their scope during the World War.

"Development work has been carried on in the matter of tracks and suspensions and a high-speed chassis has been constructed incorporating a new design of track and suspension. Its shop test to date indicates that a step forward has been made in the design of its units. Such features as are applicable will later be used in the construction of tanks.

"During the year Mr. Walter Christie has presented a combined wheel-and-track-laying chassis for test by the cavalry arm with a view to its possible use as a high-speed armored car. This vehicle is powered with a Liberty aircraft engine and has very remarkable speed both on tracks and wheels. The tests to date have been very limited, but it is hoped that further tests may determine the suitability of this vehicle for use as an armored car.

"A DEVELOPMENT which has resulted in considerable improvement in the infantry mortar ammunition over the war-time design has been actively carried on and the preliminary stages brought to a successful conclusion during the year. This ammunition is for use in the new infantry mortar which, as a result of this development, will be of the smooth-bore type. The projectile for this mortar differs from the war-time Stokes mortar type in that it is stable in flight resulting in greater accuracy. Extensive proving ground tests have been conducted and several hundred rounds have been furnished the Infantry for service test.

"Manufacture of the new design long-range projectiles for the guns that have been developed since the war has continued during the past year, and ammunition for extended service tests of these guns is being assembled.

"Designs of base-detonating fuzes for the 37-mm. and 2.24-inch armor-piercing projectiles are being worked on and a limited number have been subjected to test. Production of the major caliber base-detonating fuze is being continued and armor-piercing projectiles in the coast defenses are being equipped with these fuzes as rapidly as possible. This fuze continues to show excellent performance in ballistic tests against thick armor plate at oblique impact and it is considered that the fuze is superior to any known and in use by any other country.

"Production of the new clock-work mechanical fuze for antiaircraft is proceeding very satisfactorily. Several hundred of these fuzes have been fired this year in antiaircraft guns and the records show an accuracy in timing that has never before been obtained. One thousand of these fuzes have been furnished and are being fired in the antiaircraft exercises. This is the first extended test and it is considered that with this fuze the accuracy of antiaircraft fire has been measurably improved.

"Experiments and tests have been conducted on FNH and NH powders for weapons of calibers up to and including the 155-mm. Powders of this character were previously standardized for the 75-mm. gun Model 1897 and the 155-mm. gun. Satisfactory FNH powders have been developed for the 105-mm. howitzer, the 75-mm. pack howitzer, the 2.95-inch mountain gun, and the 2.24-inch tank gun. Experiments and development work are being conducted in an endeavor to obtain more satisfactory powders of this character for the 3-inch antiaircraft gun, the 75-mm. gun M1, and other calibers for which a satisfactory powder has not been developed. Experiments have been started on NH powder for major caliber cannon.

"A SATISFACTORY low altitude fragmentation bomb of 15 pounds weight with 5-second delay primer detonator, has been developed. Five hundred of these bombs with allways fuze and 5-second delay primer detonators are now being manufactured for service test by the Air Corps.

"Due to the failure of bombs with welded joints, there have been developed since the war, demolition bombs of one-piece with nose and tail integral with the bomb body. Due to the fact that the art of welding has progressed to such an extent in recent years, new welding processes have been developed which may eliminate the objection to welded joints in demolition or chemical bombs and make available additional sources of supply. A lot of 100-lb. bombs for high explosive and chemical filling is now being manufactured. This bomb can be made by welding nose and tail forgings to a standard seamless tube by the atomic hydrogen welding process. Studies are being made with a view to manufacturing small experimental lots of the larger size demolition bombs by welding.

"A REQUIREMENT for a semiautomatic, or self-loading shoulder rifle to replace the Springfield magazine rifle, caliber .30, has been definitely established. The development work carried on by the Ordnance Dapartment on this project since the war has demonstrated that it is practicable to build a suitable shoulder rifle of the semiautomatic type which will be as reliable and sturdy as the present service rifle, and will make practicable very much increased fire power of infantry troops.

"The problem now confronting the War Department is the selection of the best available mechanism to be incorporated in such a weapon. Since the type of mechanism and the weight of the rifle are materially affected by the power of the cartridge to be used, the question of the best caliber for such a weapon has arisen. In order to determine this question a board of officers was appointed by the War Department to select a suitable caliber, and .276 was selected after exhaustive tests as the proper caliber to be used in competitive test of guns to be presented to the board for selection of a mechanism.

"To bring about the competitive test a circular setting forth the requirements for semiautomatic rifles was issued to all interested designers and inventors, announcing a competition to be held on July 1, 1929, for the selection of a suitable rifle. This competition, or competitive trial, was

held during the past summer and has just been completed. The proceedings of the board have not yet been approved and are still of a confidential nature.

"In this test the Ordnance Department had two entries, which were developments of the War Department, both in the caliber .276. These weapons were the U. S. Model T1 (Pedersen) and the U. S. Model T-3 (Garand). Each gun is of the ten-round charger feed type, resembling very closely the service rifle and having in general its characteristics, as to weight, length, balance and other features. The proceedings of the board whose function it is to select the rifle have not been published, but doubtless one rifle will be recommended for adoption, or further development work will be recommended on some type which is favorably considered, but which is not entirely suitable in its present form."

MR. CROWELL: "The next speaker is Mr. Harold C. Smith, President of the National Metal Trades Association. Mr. Smith's organization is doing remarkable work and is vitally connected with our industrial preparedness plans. He has very kindly consented to talk to us briefly on the subject, 'The Metal Trades and Preparedness.' Mr. Smith."

MR. SMITH: "It is a good thing for us to be here today to rekindle and keep alive an intelligent interest in a problem so vital to our national welfare. This demonstration is of particular significance, I believe, to us of the metal trades industry for in it we see many evidences of the handiwork of our own field of endeavor. It is indeed a far cry from the hand to hand combat of ancient times, to war of today.

"The machine age has asserted itself in war as well as in peace and with this evolution of mechanized conflict the metal industry has taken on added importance. Today the majority of the materials of peace are essentials in time of war. Feeding and clothing the soldier as compared with the civilian, is not essentially different in its demand upon agriculture and textile factories. However, equipping an army with ordnance of all types makes quite a different requirement on the manufacturer. With the World War fresh in our memory, we need not look far for proof of this statement. The thrilling drama of the country girding itself for battle was as evident in shop and factory as in the training camp.

"American industry in 1917 was on a peace basis. Its experience in the manufacture of ordnance and war materials was limited. It necessarily took much time to transfer the knowledge from Government arsenals to the private manufacturer. Even in cases where types of equipment in use by our Allies was adopted for America, it took time before the foreign specifications could be perfected for use in the American factory.

"IN the early days of the American participation, our troops were partially supplied, in some instances, with equipment made in England and on the Continent, but this simply made for the depletion of the supplies of our Allies. Through the coöperation of the War and Navy departments, and the energy of the American manufacturer, this condition was overcome and in 1918, American industry was largely meeting the ordnance needs of the American soldier and sailor.

"Personnel needs of the Army and Navy required mobilization of not only unskilled, but skilled men by the hundreds and thousands. A tool or die maker lost from industry was a problem. Machinists, machine operators, the steel mill worker, the machine designer were vital to production. Skilled men could not be satisfactorily replaced. Successful manufacturing was a necessity, since the success of every battle depended upon supplies and interchangeability of parts made with rigid conformity to our Army's high standards. I am proud to say that the members of the National Metal Trades Association were not found wanting in the crisis. Our member companies manufactured guns and howitzers, gun carriages, shells, forgings, fire-control apparatus, fuzes, helmets, Liberty motors, trucks, in addition to dies, gauges, tools and fixtures, which are a basic need in all manufacture.

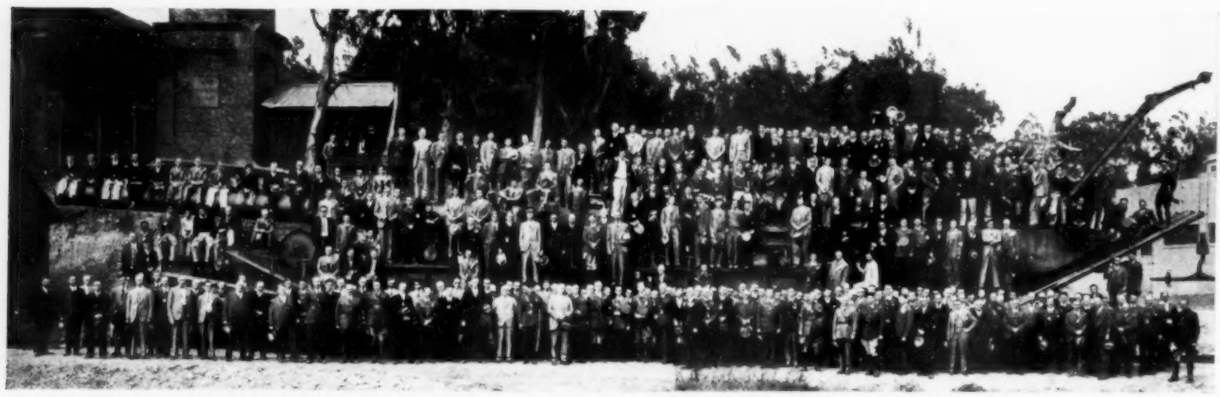
"BUT glorious as was the record of industrial America in that crisis of eleven years ago, we would be blind indeed if we did not recognize that grievous errors were committed; that there were costly delays and enormous waste. As I understand the aim and purpose of the Army Ordnance Association, it is to reduce to a minimum the possibility of those errors and delays recurring in the event of another war. I think that that purpose is a reasonable and commendable one and it is my hope that in the future there can be a better understanding and a closer coöperation between your Association and the manufacturers of the country. I have outlined briefly some of the activities in the last war, with the idea of indicating the necessity of a program of service for the future.

"A satisfactory plan of industrial preparedness requires that a considerable number of factories have the necessary knowledge and experience to produce ordnance and ordnance supplies of the latest types so that they may be familiar with the work required in case of a national emergency.

"The able article by Brigadier General Ruggles, Assistant Chief of Ordnance, which appeared in two recent issues of the *Army and Navy Journal*, clearly pictures the important place which manufacturing industries occupy in the event of war and outlines in detail the advantage of the program contemplated by the Educational Orders Bill, as recommended for enactment by the Committee on Military Affairs of the House of Representatives, and in a similar bill introduced in the Senate.

"Those who are working for arms reduction should be the first to espouse such a program as a cheap, indispensable feature in the defense of our country. Let us, as manufacturers, in turn visualize our responsibilities and be ready to coöperate in carrying forward such a program which means so much to our country and its people."

MR. CROWELL: "In closing I want to thank all of you for your interest and coöperation and especially the National Aeronautic Association and the National Metal Trades Association and the various branches of the Army which have assisted so splendidly toward the success of this gathering. I should like to thank and congratulate General Williams and the officers of his staff and Colonel Shinkle and the personnel of the Proving Ground for this splendid and instructive exhibition of ordnance progress."



Second Annual Meeting, California Post, Army Ordnance Association, Benicia Arsenal, California, September 19, 1929.

Epochal A. O. A. Meeting on West Coast

California Post Presents Program at Benicia Arsenal

By George F. Lemon*

THURSDAY, September 19, 1929, marks an epoch in the progress of the Army Ordnance Association on the Pacific Coast. On this date the San Francisco Post of the Army Ordnance Association acted as host to the San Francisco Sections of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Institute of Radio Engineers, the Departments of Military Science and Tactics of Leland Stanford University and the University of California, and prominent individuals of the engineering and manufacturing world, at a meeting held at Benicia Arsenal. This is the first of what is hoped to be a series of similar annual affairs, in the course of which intimate contacts may be made with all west coast engineering and manufacturing organizations, thus establishing the close relations and understanding between the Ordnance Department and manufacturing organizations which are so important and essential in working out the problems of the production of Ordnance matériel.

Maj. George F. Lemon, Commanding Officer, Benicia Arsenal.

Viewed from all angles, the meeting was an unqualified success. The total attendance was 376. Those attending were men who were acutely interested in, and who thoroughly understood, the explanations given of the matériel displayed to them, which consisted of over 500 items of ordnance matériel—ranging from carpet tacks to 14-inch railway artillery—and even well informed ordnance officers found articles on display they had never seen before. Among the guests were Rear Adm. Geo. W. Laws, U. S. N., Commandant, Mare Island Navy Yard, with a number of his staff; Col. L. C. Brown, Commanding Officer 30th Infantry, Presidio of San Francisco; Mr. Pliny E. Holt; Capt. Bruce Canaga, U. S. N., Professor of Naval Science and Tactics, University of California; Senator Thomas McCormack, California State Legislature; and Mr. C. R. Harding, Engineer of Standards, Southern Pacific Company.

For those who came by boat the day began at 7:45 A. M. when the guests embarked on the steamer SLOCUM at Fort Mason, furnished by the Quartermaster Corps, U. S. Army, for a delightful and interesting sail up San Francisco Bay and Carquinez Straits arriving at Benicia Arsenal dock at 10:30 A. M.

The matériel on display at Benicia Arsenal was grouped in ten exhibits or stations, each station in charge of a director whose duty it was to explain in detail the features of that particular exhibit. These station directors were non-commissioned officers of the ordnance companies stationed at the arsenal and each one was thoroughly conversant with the use, supply, and maintenance of his particular items. The guests were grouped in sections containing approximately 20 men, each section in charge of a guide who directed his section to the next succeeding station. A continuous movement in one direction was maintained. The number of spectators at any one group was limited so that there was no overcrowding, and each spectator had an unobstructed view.

At 12:30 luncheon was served by the ordnance companies from funds furnished by the Benicia Chamber of Commerce. At this time the Commanding Officer of Benicia Arsenal made a short address of welcome to the guests and introduced the various speakers.

MR. DENNISTOUN WOOD, Past Chairman, San Francisco Section, American Society of Mechanical Engineers, said:

"At the August meeting of the San Francisco Section of

*Commanding Officer, Benicia Arsenal, Benicia, California; Major, Ordnance Department, U. S. Army.

3-inch Antiaircraft Gun Exhibited at California Post Meeting.

Mechanical Engineers, Colonel Wood of the Regular Army and Major Moody of the Reserves gave us talks supplemented by very interesting pictures in connection with national defense, and we were told what the Army expected of the engineers in civil life in connection with preparing for war—this with a view to doing away with the confusion and lack of supplies that existed at the time of the World War. I think that those of us who were at that meeting will agree that it was well worth while. This meeting today well supplements that August meeting. We have been shown what the Army is doing and what it uses in the way of ordnance supplies. We are given an idea of what we will be expected to furnish should the time come when such material is needed in quantity.

"It has been a custom for some time past each year for the Army to invite engineers in civil life to visit the Proving Ground at Aberdeen, Maryland, and, from what I hear, those visits are most interesting. May we not hope that Benicia will come to be to those of us on the west coast what Aberdeen is to the engineers of the Atlantic Seaboard, and that each year at this pleasant fall season we may come to Benicia and see the new developments in the way of Army matériel. On behalf of the Mechanical Engineers, I want to thank the Commandant of Benicia Arsenal, the other officers of the various departments of the Army, the members of the Chamber of Commerce of Benicia, and the Army Ordnance Association for making possible this very instructive and enjoyable trip today."

DR. L. F. FULLER, Chairman of the San Francisco Section, American Institute of Electrical Engineers, was then introduced. He said:

"In introducing me this afternoon, Major Lemon has made reference to vacuum tubes and radio equipment. My thoughts today have been far from such devices and on things much heavier and more powerful. These large rifles we have seen may be considered as single cylinder, internal combustion engines, and I have been doing a little speculating regarding the horsepower they develop. With the assistance of some figures and information obtained from ordnance sources, I have done a little computing, because as an engineer, I can think in terms of horse power, kilowatts, and kilowatt hours with more facility than in muzzle velocities and foot tons. Thinking that these figures may be of interest to you, I have brought them along, and with your permission will discuss them briefly.

"You will recall the 75-mm. rifle we saw in this building this morning. The energy transferred to the shell during its travel down the rifle bore amounts to about nine-tenths of a horse-power hour, but it is delivered to the projectile in such a short space of time that the actual horsepower developed is approximately 604,000.

"You will recall the 14-inch rifle on the railway mount just outside the building. The ordnance tables have some figures on the 16-inch coast defense rifles from which the horse power can be computed. The projectile from this gun has about 146 horse-power hours stored in it as it leaves the muzzle. The time during which it is actually in motion along the bore of the gun is so short that the actual horsepower developed during this period is approximately 12,000,000.

"In recent years the electrical engineer has come to understand enough of lightning and steep wave front discharges to speak with some assurance regarding the horsepower developed in a single lightning stroke.

"If I quoted figures as to the horse power or kilowatts developed in a single stroke, I feel it would mean little because of the wide variations in the size of such strokes in nature. Fortunately, however, we can refer to some specific equipment such as the lightning generator, which has been installed within the last few months at the Harris J. Ryan High Voltage Laboratory, at Stanford University, California. Many of you are no doubt familiar with it. This generator dissipates energy not in excess of 45/100,000 of a horse-power hour at each stroke, a rather small figure compared with the 146 horse-power hours stored in the projectile of the 16-inch rifle. This electrical energy is sufficient to light a 20-watt lamp about

Student of Ordnance Unit, University of California, Demonstrating Chronograph at California Post Meeting.

Visitors Inspecting 14-inch Gun and Mount at California Post Meeting.

one minute but the time in which it is dissipated may be as low as one millionth of a second, so that the actual rate of energy dissipation is approximately 1,600,000 h. p.

"I have compared this high rate of electrical energy dissipation with what occurs in modern artillery in order that we, as electrical and mechanical engineers, may have a better understanding of the matter. Due to our training and daily work, we are probably more appreciative of the difficulties and the time required to work up designs and produce ordnance than citizens in many other walks of life. If these meetings may be made an annual affair, as I sincerely hope, they will help us to keep in touch with these activities and to pass on to our friends and acquaintances a better understanding of some of the problems the Army has in hand.

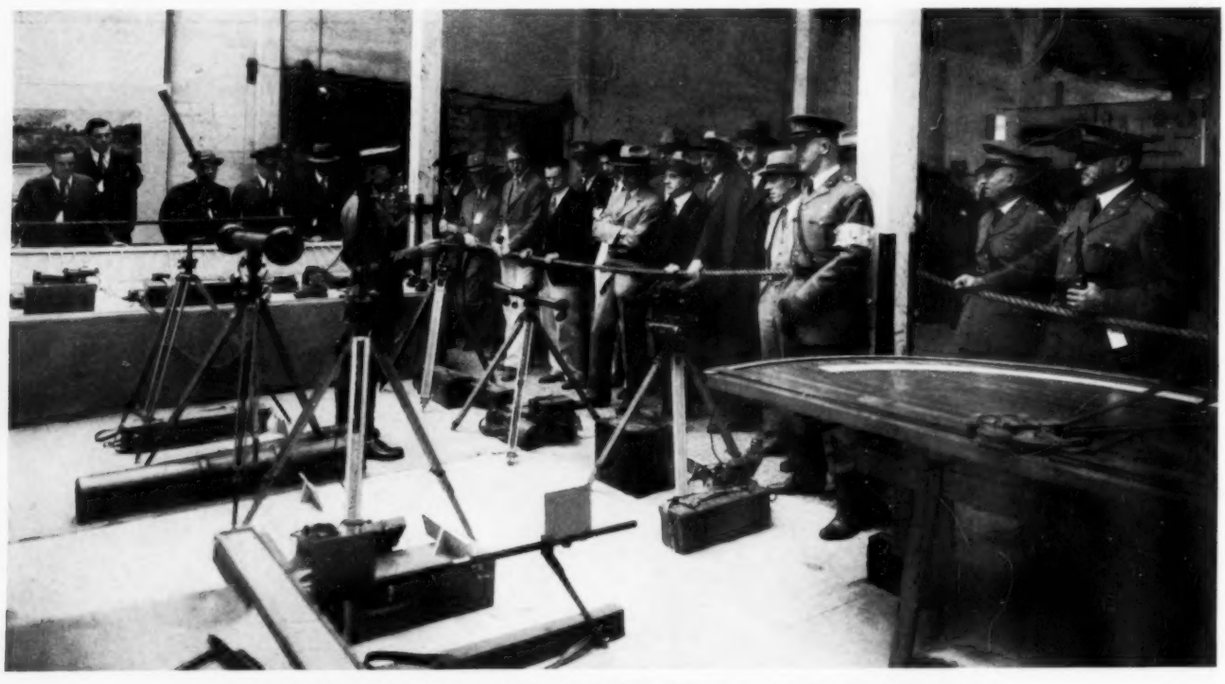
"The San Francisco Section of the American Institute of Electrical Engineers is deeply grateful to the Commandant of the Arsenal, the Army Ordnance Association, and all those who have made this trip here today possible. We are keenly interested in this ordnance work and will gladly coöperate with the Army Ordnance Association in a continuation of such splendid meetings as we have had here today."

Capt. John A. Marshall of the University of California made a brief speech in which he recited some of the problems involved in the production of propellent powders.

Maj. Gen. David P. Barrows, California National Guard, then was introduced. General Barrows is California's outstanding citizen soldier and his remarks were received with intense interest. His address is published in full in the following pages.

At the conclusion of General Barrows' speech, the guests were assembled for a group photograph and then witnessed demonstration firings.

It is the opinion of those interested that this meeting was of great importance in familiarizing manufacturers on the Pacific Coast with ordnance problems and ordnance matériel, and in solidifying their interests and understanding.



Fire Control Exhibit, Second Annual Meeting, California Post, A. O. A., 1929.

Professional Inertia and Preparedness

Address by General Barrows at California Post, A. O. A., Meeting

FIRST, I want to express my enthusiasm for this really notable gathering. I had little appreciation, when invited to speak here, of how well qualified would be the personnel of this meeting. I am gratified through and through by what this assembly represents — a meeting of leading minds on the technical side of mechanical production, from our laboratories, universities and factories, consulting with elements of the several branches of the Army. Something will come out of this, I feel sure, that will bring to those of us who represent the Line, an assurance which we greatly need.

EVER since the war we have been made increasingly aware of the fact that in all countries there has been an extraordinary effort made to gather, analyze and preserve the knowledge of that great conflict. Our Regular Army has been reduced today to very small proportions, nevertheless, it is charged with the highest conceivable responsibility: to preserve and develop our military knowledge. There is a widespread misapprehension that knowledge once gained is permanently at the service of future generations, that it is never allowed to slip back into the limbo of forgotten things. I believe this to be a fallacy. Over and over again in human history, knowledge gained at great cost has been completely lost, and in an incredibly short time. And this is truer of military knowledge than any other sort of knowledge. Our Civil War is a perfect illustration. Our Nation came out of that conflict with a knowledge of battle, of tactics, of arms, and of all branches of supply that was superior to anything in the world. We deliberately let it go and we have been at many times since that day forced to make efforts to regain that knowledge and I doubt if we have recovered much today. The highest service to national defense that can be rendered by any body of men is that of preserving, analyzing, and passing on the hard bought knowledge that comes out of war—that is today the primary business of our Regular Army.

I picked up in Washington not very long ago a volume that illustrates what I have said. It was a report made by a French Officer, General Dechanal—of the Second Empire—who came to this country to investigate the American Army of 1864 and 1865. It is a mine of information. It shows the point to which American warfare had progressed—particularly in the Army of the Potomac. All sorts of things are covered in that report. It answers many questions as to arms, organization and supply. And yet I have never known this work to be cited by an historian of the Civil War. It is an illustration of the way that knowledge may be allowed to slip and be lost.

In a recent essay "Lee—The Soldier," a great English soldier and scholar, Gen. Sir Frederick Maurice, asserts that if the British Army had only studied the principles of Lee's defensive strategy during the last two years of our Civil War, the duration of the World War

David P. Barrows,
Major General, California National Guard.

General Barrow's Record

BORN in Illinois in 1873 General Barrows' family moved to California shortly thereafter. He spent his boyhood on a ranch, graduating from Pomona College in 1894. Following his graduation he took post-graduate work in political science and anthropology and in 1900 Ex-President Taft, then in charge of the Philippine Commission, placed him in charge of the Manila Public Schools. From that time until 1910 General Barrows served successfully in important educational and administrative positions in the government of the Philippines. During this time he was largely responsible for the organization of the educational activities in the islands, serving as Director of Education from 1903 until his return to the States in 1910.

His connection with the University of California started with his acceptance of the Professorship of Education and then of Political Science. Later he served as Dean of the Faculties, as Acting President 1912-1914, and as President of the University from 1919 to July, 1923. During the World War period he served under Mr. Herbert Hoover in charge of the food supply in the city of Brussels and after the entry of the United States into the war he served as a field officer in the Philippines; in Manchuria and Siberia as military observer, and then upon the Staff of the American Expeditionary Forces in Siberia in 1918. In 1921 as a Colonel in the National Guard he assumed command of the 159th Infantry; then as Brigadier General in command of an Infantry Brigade; in 1926 he assumed command of the 40th Division of the National Guard with a commission of Major General in the federally recognized service.

This record of public service appears against a remarkable background of activity in many other directions. His service in the educational and social development of California has been noteworthy. He has devoted much time to travel, always as an explorer or observer. He spent the winter of 1923-1924 in northwestern and central Africa visiting Timbuctoo and crossing the French Sudan—a journey of over 2,500 miles through little known regions in interior Africa. Other travels have covered almost all the regions of the globe. From these trips there has come an abundant contribution to the social and technical literature upon the conditions and problems of the regions visited and especially upon their relations to the United States.

This is a brief record of a career of achievement in many fields. As educator, executive, scientist, world traveler, humanitarian and professional soldier, General Barrows brings to any subject to which he may address himself a remarkable breadth of view.

might have been shortened by one-half. So I press the point that unless our dearly won knowledge of war is committed to a permanent body of professional experts, it is pretty certain that much of it will be lost. This professional element in our national plan of defense is the Regular Army.

NOW to return to what I spoke about a moment ago—the Line forces have been and are in the midst of great perplexity. We have had new weapons given to us since the World War, but we are aware that a mechanical progress is taking place which may render obsolete even these new weapons and the system of tactics that goes with them. We feel that we have not yet adapted our organization, our tactics, and our training to what may be expected to come out of this amazing advance in the field of mechanical invention. We feel that the next advance of scientific knowledge may render futile our armament, our plans and our training. We need the assurance that we can rest upon the continued interest, and expert services of such laboratories, factories and professions as are represented by the gentlemen in this hall.

I am speaking wholly for the Line, because my experience qualifies me only to speak with appreciation of the difficulties of the Line. But it is obvious that we must tie up with Ordnance, and we must look to the Ordnance Department for the validity of our training, and Ordnance must have help on a nation-wide scale.

There is a common feeling that the Line will go out and by its training and experiments discover what it needs and then tell the Ordnance Department to produce it. I do not believe experience justifies this assumption. We have filled American homes with mechanical devices of every sort—but the housewife has not contributed to the production of these inventions. The farmer has been given many mechanical devices—tools which have revolutionized farm production. But they have been invented, and really forced upon him by men who were not farmers. This is what the Ordnance Department must do for the Line. Men who are thoroughly trained in the use of an accustomed weapon and who have trained other men in the use of that weapon, although it may clearly be obsolete, will stick to that weapon unless you wrench it out of their hands.

I recall an Infantry officer at the opening of the World War who had had the greatest success in training troops in the use of the Army rifle. He did not believe that there was any other weapon for the infantry soldier. His mind was steeled against the machine gun. His very devotion and success blinded him to the decisive results on formations and tactics produced by mechanical fire. Take our belated adoption of the hand grenade.

Twenty-eight years ago I spent a good deal of time in what we call the "Moro Country" in the Southern Philippines. I was at that time Chief of the Bureau that had oversight of the Pagan and Mohammedan peoples. Those were the days of bloody warfare between our Army and the Mohammedan Malays. What this warfare usually amounted to was the capture by infantry of little fortresses or cotas. The Malay people build these fortresses with high stone and mud walls, surrounded by deep fosses and further protected by thick growth of thorny bamboo called cauayan. Again and again our troops stormed these cotas and fought it out hand to hand with a veritable bunch of wildcats within. One would suppose that these experiences would call for the development of the hand grenade or bomb. It would have solved the problem and saved many lives. About 1909 a very notorious Moro outlaw named Jakiri was the head of a band of Sulu outlaws. He extended his raids over considerable water areas and many islands. He was finally driven into a cave on an island near Jolo. There he was bottled up with the remnants of his forces. Attempts to get him out of that cave were made for several days. Finally the troops went in and got him, but at considerable cost of life and numerous injuries. A few bombs or a little gas would have settled the matter quickly. I don't want to assert that the Line is *lacking* in inventive genius, but somehow it gets far behind in appreciation of the need or the possibilities of new arms. Conservatism in the choice of weapons is doubtless a profound human trait.

I was turning over yesterday the leaves of Mr. Philip Guedalla's "Life of Palmerston" in which several chapters are given up to the curious performances of the English War Department during the years of the conflict with Napoleon, 1805-1815. There was a meeting of worthy members of Parliament in which one member moved, "to revert to the ancient and *Constitutional practice* of making our artillery of leather instead of following the Continental practice of having them of iron or brass." From which you see, old and fixed ideas with re-pect to arms are hard to get out of our minds.

ANOTHER reason why the Line may not be counted on to improve its own arms is that it lacks time to follow mechanical developments. Discovery, invention, demonstration and salesmanship must come from the outside. We must look to the Ordnance Department and the Ordnance Department must look to professions where mechanical improvement is constantly stimulated by the competitive struggle of a mechanical age. The Ordnance Department, as has already been pointed out by our Chairman, is limited in its resources and limited in its personnel. It has a body of officers and men who are devoted and competent, but it must have the organized assistance of all technical men in civil professions who are ready to help keep this country in a state where it can defend its national interests. Hence, I repeat, the importance of this very interesting meeting.

Another reason why it is difficult for the Line to branch out and try alterations and improvements is that the policy of uniform training forbids it. Inevitably the effort to impart an approved doctrine, or an approved drill manual stifles initiative because initiative is a departure from the common standard. An officer who exhibits initiative finds that his attitude is met with decided opposition. It is actually damaging to a junior officer to urge the development of means outside of the approved armanent of warfare. You are a body that can criticise and experiment because you are free from such limitations. Innovations come largely from such men as you, and I do not say this by way of Army criticism, because the situation cannot be avoided. In 1915, I spent the summer in Mexico. I was with a remnant of Pancho Villa's army at Casas Grandes. Villa's forces were very small and limited in resources. He had to utilize everything he could pick up locally. But,

with all his brutish traits and lack of training, he was a very clever man and he had some clever officers about him. They improvised several things in which they anticipated the combat tools that European armies sometime later employed. Villa took Casas Grandes. The town had been burned over before he captured it. There was a large roofless commercial house with solid walls where the remnants of the government forces barricaded themselves and held successfully. Lacking artillery it was a hard nut to crack. Villa's ingenuity devised the bomb. He fabricated them and so destroyed a strong point by bombs, long before the American Army had them. He was not embarrassed, as a Line officer necessarily is, by superior authority, critical of innovations.

SO your business as I see it, Gentlemen, and that of the Associations represented here is to see if you can work out for us, demonstrate and sell to us the highest types of mechanism applicable to combat. But there is a condition which the Line wishes to impose and must impose. I read lately an interesting document, a chapter of which reads in summary something like this—"The Navy is mechanized; our factories are mechanized; our farms are mechanized; our homes are mechanized—why shouldn't the Army be mechanized?" Well, that is a challenge. But there is one thing that makes an army different from a fleet, a factory, a farm, or a home. It moves on the ground. The fleet is naturally mechanized. It can be, because it floats on the seas. The factory is mechanized because it is fixed, and so is the home. The farmer can be mechanized because the farm does not move. But land warfare is different; it moves; it has got to be mobile. It can sacrifice none of its "lightness and freedom." Very significant experiments are going on now, especially in England, which have for their objective the restoration to warfare of the mobility which it has lost. Whatever you devise for us, remember that we will have to pack it along; take it with us; handle it; if it is an ammunition consumer we must pack the ammunition; if it is a machine we must repair it in the field and even in action. The most useless weapon is one which hinders and does not help mobility on the ground.

YOU are probably familiar with something I mentioned a moment ago—the efforts made in recent years by officers of the British Army to restore the mobility to the offensive. One interesting writer is Capt. Lydell Hart whose rather critical essays upon the great leaders of the World War—Joffre, Haig, Foch, Pershing and others have attracted much attention. He has written quite a radical book on the Mechanization of Armies. A more judicious book, I think, is one by Colonel Fuller and another by Major Benet. Benet recognizes this—that you cannot use mechanization on the field of battle in all situations. The great field for mechanization is for major wars against foes able to put great forces into the field, that will stand in the field and meet your attack or deliver their own. There is necessarily much difference in the methods of future warfare according as combat takes place in different countries, climates, and with different peoples. Major Benet recognizes that there must be elements in the British Army particularly mobile in view of the widespread character of their possible operation. There must be for those forces one type of soldiery, one type of armament, mechanized only as far as possible in view of its mission and the character of the country where it serves. A great deal of future warfare will be minor operations on terrain that is not adapted for mechanized forces nor for highly specialized mechanical devices.

A little over a year ago I spent some time with our Marine forces in Nicaragua. They were not standing on the defensive. They were going out to get the guerrilla. They had to discard certain weapons. They could not use their machine guns. They had to cut their equipment down to the rifle, revolver, hand grenade, bayonet, and another weapon, which was very popular among them, the Thompson sub-caliber rifle, a little rifle that shoots pistol ammunition. This rifle shoots from the hip, can be used as a spray, and it proved very effective in the thick jungle. (Editors note: not an Ordnance Department development, but developed by an Ordnance Officer.) We have been much interested in a rubber-tired handcart for the machine gun and its ammunition which promised mobility for this weapon where a mule could not go. But Nicaraguan trails were so rough on these rubber tired wheels that they used up a great number of these handcarts, and they were finally discarded. It is part of the problem of the Ordnance Department to work out the proper armament for *all types* of warfare in which our troops may be engaged. Such provision means the saving of lives, the accomplishment of the objective of warfare. It means something else; it means *promptness of the military decision.* In all our various wars in a century and a half, during which we have one year of warfare to each three and a half of peace we have never been able to get a *quick decision* but once, and that was in the Spanish American War which lasted but 113 days. In all the rest of our wars we have been victorious in the end, but only after a protracted and expensive effort. I judge that there is nobody here who wants war, or who probably will be able to influence much any decision to make war or to keep the peace. But for those who may have to bear the burden of war if it comes, I say that the thing that we are interested in is *a short war.* And a large part of our preparation; including certainly our armament, should be directed to gaining a quick decision. Somehow or other we must find the means for an offensive which will act powerfully, decisively, and quickly.

I WANT to refer to one thing more. The thing that the British seem to rely upon now is their tank. I had sent me the other day a confidential report. It is very interesting history of the development since 1919 by our Ordnance Department of our new tank. In place of the four or five miles that could be made with the old tank with which we are now equipped, this admirable new tank which has finally emerged and which seems to be so very handy, can make twenty to twenty-five miles an hour. The old tanks had to be repaired every fifty miles, against the new tank's radius of 2,000 miles of action. The new tank carries both a 37-mm. gun and a machine gun and it is operated by a crew of two men. The turret or "movable pillbox" is mounted upon a *universal chassis* that will fit not only a tank but also provide a carriage suitable for many other military purposes. In this, we may have the finest chassis in the world. The only trouble is we have only five of them! The difficulty here is a matter of supply. Our great pro-

ducers of caterpillar automotive vehicles are not producing fast tanks because there is no commercial demand for fast vehicles.

I am trying to bring out this fact that we are seeking mobility; we are seeking a quick decision—the thing we want is speed. So the Army, particularly the Ordnance Department, is at the present time dependent upon itself for the development of these high speed chassis. The thing however that is so interesting is this—the Ordnance Department initiated the study and development of tanks in 1919. It had elaborate contact and communication with our infantry bureau and Line officers and it has succeeded I judge, in the splendid way it has, because it worked for years in the closest sort of coöperation with representatives of the great body of automotive engineers in civil life. That is the kind of coöperation we need in the development of arms.

I LIVE at the University in contact with men who are interested in the study of anthropology and human geography. What seems to be filling their minds now is the historic causes of human migrations—how one type of early man shoved another type out of the way, gained advantage of location, and became civilized. The explanation lies in arms. It was the momentous discovery of new and more effective types of arms that gave one tribe or race of man advantage over another and enabled him to crowd out less fortunately armed types of man from the choice regions of the earth. The lowest types of mankind are on the fringes of the inhabited world where better armed races have pushed them.

At all times we must know what the other nations are doing. We should know what the Russians are doing. They are in numbers the great nation of the white race. Their standards are the largest gauges in the world. They believe in size and quantity and in mechanization. They are capable of extraordinary bursts of energy. They have not renounced war. They hold the rest of the civilized world in enmity. While we have developed a 7½-ton tank, they are said to have developed a 70-ton tank! Just what they are going to do with it, I do not know. But they are gifted in the development and use of mechanical inventions and they have the vision and may sometime do things on a very great scale. I call your attention to the fact that by recent accounts in the papers of the warfare in Manchuria the XVIII and XIX Russian Army Corps are able to bluff and stand off 370,000 Chinese troops and that they are using a mechanized railroad force that comes over the frontiers in attacks and raids. (Note—See D. P. Barrows' Russian Broneviki or Armored Trains in *U. S. Cavalry Journal* for March, 1929.)

To come back to the original theme. I want to express my great pleasure and gratification in this meeting. It has been a wonderful thing. I see, I hope, a way out of the anxiety which at the present time rests upon those of us who are not at all sure that we are training troops in such a way as to obtain the best results; who fear that we may fail through failure to use the enormous achievements of this mechanical age.

The first thing, is produce the arm, demonstrate it, and give it to the line, then adapt and reorganize troop organization and tactics *to fit that arm*. The arm comes first. Organization and tactics follow the weapon.

Editor's Note: General Barrows' comment on professional inertia applies with equal force to ordnance. It should be remembered the Ordnance Department, as well as other technical branches, has the same inertia of conservatism to overcome. A designer who has grown familiar through years of use on his drafting board with certain standards and formulas and equations, or the shop manager who has used certain methods and tools, is just as impregnable to new ideas and new inventions as is the infantryman of the last generation who relied on his rifle and rejected the machine weapon.

Board Recommends Comparison Tests of Garand and Pedersen Rifles

THE Board of Officers, of which Brig. Gen. George S. Simonds, Assistant Chief of Staff, was President, which was convened to conduct tests and to recommend the adoption of a caliber .276 automatic rifle, in conducting the tests which began on July 1, 1929, tested nine rifles as follows: Browning, (Belgian); Colt, (American); U. S. Model T3, (Garand); Czecho-Slovakian; U. S. Model T1, (Pedersen); Thompson, first model (American); Thompson, second model (American); Rheinmetall, (German—Manufactured in Switzerland); White, (American).

The tests were conducted at the Anacostia Range, D. C., and at Aberdeen Proving Ground, Md. They were exhaustive and much more severe than the tests given the Pedersen rifle by the Infantry and Cavalry Boards. Of the nine rifles submitted the board finally eliminated from consideration all but the Garand and Pedersen. These two rifles demonstrated general suitability as service rifles.

In considering the Garand rifle, the board found that it demonstrated many qualities which would warrant its further consideration. The most important of these are its great simplicity and fewer parts. However, the Pedersen rifle already has been given tests in the hands of troops at Fort Benning, Ga., and Fort Riley, Kan. In view of this, the board is of the opinion that similar action should be taken in connection with the Garand before a final decision is made.

In making its recommendation, the board was influenced by the following facts: (a), the Garand rifle gives sufficient evidence of suitability to justify the manufacture of twenty for a service test with troops; (b), there will be no money available until the 1932 budget for the manufacture of any for rearmament; (c), the Ordnance Department has at the present time sufficient funds to manufacture the number of Garand rifles recommended by the board. As a consequence, they can be manufactured and the test held before funds will become available for rearmament.

In the opinion of the board these circumstances justify holding open the final question of the settlement between the two rifles until that time. Should the Garand fail to measure up in the test with troops, the Pedersen which has been found satisfactory to them will still be available. Both rifles are controlled by the Ordnance Department.

Ordnance at West Point

Teaching Future Army Officers the Basic Design of Weapons

By Earl McFarland*

THE course of instruction at West Point is for the purpose of training for leadership and command. The function of the Military Academy, then, is to produce men who will eventually become high staff officers and commanders. Therefore, the curriculum, basically, comprises those studies which develop the cadet's thinking and reasoning ability, and instill in him the assurance that difficulties can be overcome by hard work. But West Point must also produce active and efficient second lieutenants for the Army. The course therefore includes much of athletics, much of tactics, and much of military technique. We see that mathematics plays a very important role in the education of a cadet and is the natural basis on which mechanics, and chemistry, and mechanical drawing, and engineering, and ordnance and gunnery are built. But English and history and economics and foreign languages are required to balance the course and the *mind*—and these more distinctly cultural subjects predominate over the pure science in the cadet's four years' work.

The Military Academy is conservative—and rightly so; for it is built on a solid structure which, with great success, has passed through the storm of every war of the Country and has lent its hand to the upbuilding of the Nation in time of peace. But its conservatism is not in opposition to removing the old nor resisting the new. Indeed the course of study, the method of conducting recitations, the use of laboratories, the management of cadets, the new architecture — the very atmosphere of West Point—show continual change and progress and advancement.

Colleges and universities are for education; and West Point is for education. But in addition to the more usual courses as studied at college, the cadet devotes many hours to distinctly military instruction: infantry, artillery, cavalry, and athletics are part of his out-door practical work; tactics, military history, military engineering, and ordnance are part of his academic curriculum.

NOW what is this study of ordnance? Does every cadet become an ordnance officer? Does he take a complete course in ordnance design? In ordnance automotive construction? Must he understand the intricate details of the French 75-mm. recuperator? Does he learn to construct a ballistic table? Is he familiar with yaw and the precessional movement of the projectile as it flies through space? Yes—and no.

In the first place, he does not become an ordnance officer. The course is not intended to meet the requirements of ordnance officers or ordnance engineers, but is planned for the needs of the *officer of the line*. It does not favor any particular branch of the Army but includes matter which all officers should study, regardless of their branch. With a fair groundwork in the sciences and a knowledge of the basic theories and principles of ordnance, the officer after graduation may pursue such a detailed course of study on the ordnance of his own arm as he desires.

The course in ordnance extends throughout the first class or senior year of the cadet. Attendance is for one hour and fifteen minutes every other day. The class is divided into sections, each section containing from 12 to 15 men. The sections are arranged according to the standing of the cadets, so that men of equal mentality and alertness are generally in the same group. Ordinarily, recitations are held in small section rooms, each section having its own room and its own instructor. Because of this arrangement, each instructor has a small group to handle and all men in this group are capable of about the same mental attainment. While the requirements are essentially the same for the whole class, the method of presentation by the instructor, the amount and detail

The Portal.
Entrance to Administration Building, United States Military Academy.

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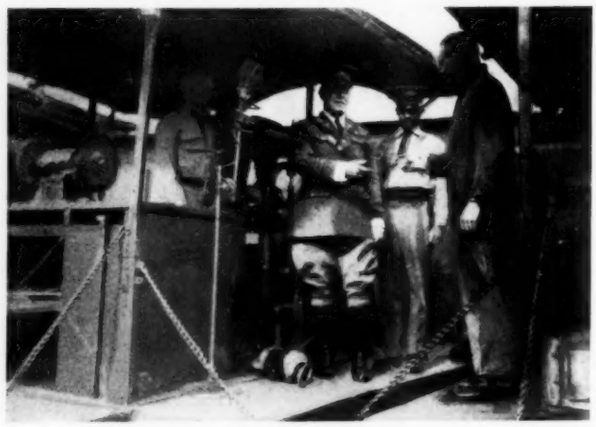
of explanation given, and the degree of thoroughness required of the cadet vary with the section.

The instructors are usually officers of the Ordnance Department of the Army, graduates of the ordnance schools and the special course at the Massachusetts Institute of Technology. They are especially selected for the job and have the personal characteristics and the background, interest and understanding to form a satisfactory teaching staff. One officer of artillery is generally selected for duty with the department, to add the line viewpoint to the instruction.

THE course consists partly of theory intended to develop the mind and emphasize the practical application of the chemistry and mechanics studied in the second class year; partly of a study of service ordnance matériel and its mechanisms; and partly of practical shop work and the manufacture of metal articles.



The Superintendent Inspects.
Maj. Gen. W. R. Smith examining the work produced by cadets who are operating an Ordnance Repair Unit.

The Army man should know more than the mere names and uses of propellants and high explosives. The chemical formula, reaction on explosion, quantity of heat liberated, and capacity for doing work should be understood. The application of Avogadro's law and the laws of Boyle and Gay-Lussac must be studied so that the student may have a thorough comprehension of the theoretical side of explosives.

Because of the importance of smokeless powder in a military program, the manufacture of this substance is studied in some detail; and the sources and general methods for producing high explosives, such as TNT, explosive D, and tetryl are pointed out. A table of the forms of charge used by service weapons is presented and the precautions to be followed in the use of blank and special ammunition are given.

Nitrogen is one of the elements essential for the development of a munitions program. The cadet is given instruction in the sources of nitrogen, the methods of fixation, the possibilities of fixation in the future, and the research work now being carried on by the governmental and commercial agencies.

The subjects of interior and exterior ballistics are not considered from the point of view of the ballistician but rather from that of the battery officer who is interested in the possibilities and limitations of his matériel.

In interior ballistics, the Le Duc formulas are explained and discussed and illustrative problems involving their use are presented. The cadet is required to learn the use, application, and meaning of these formulas, the effect of changes in matériel upon interior ballistics, the use of standard powders, and effects of varying ignition. He becomes familiar with the importance of web thickness, the distribution of energy of the powder gas, the results of erosion in the bore and similar matters.

The subject of exterior ballistics also is treated from the line-officer's viewpoint. It is assumed that the theory of the motion of the projectile "in vacuo" and in the air must be understood by the student before he can apply intelligently the data contained in firing tables in the solution of actual problems. But much greater stress is given to the solution of problems in artillery fire and to the use of firing tables than to the work of the ballistician or of the proving ground personnel in computing the general ballistic tables.

The work at the proving grounds and the instruments used at these establishments are always of particular interest to the users of the things tested. So a rather detailed study is made of the function of the proving ground, the conduct of tests, and the operation of the different chronographs, pressure gages, and other instruments.

THE manufacture, working, and treatment of metals used in ordnance construction is of great and general interest, particularly as these metals are also used in the production of automobiles, airplanes, ships, and so many other articles seen in this machine age. The close relation between metals used for commercial purposes and metals used for ordnance purposes is put forcibly before the cadet; and he is made to realize that a munitions program is absolutely dependent on the manufacturing capacity of the country's commercial concerns.

When the basic principle of gun construction is encountered and the cadet is faced with the many equations used in the solution of the problems of gun construction, he is inclined to lose interest in ordnance engineering as a career. The "limiting value of exterior pressure acting alone," on a cylinder, rather stumps him. But finally he is able to understand the more simple problems in shrinkage and can then proceed to a practical study of guns.

The history, manufacture, advantages, and disadvantages of built-up, wire-wrapped, and cold-worked guns are taught at some length. A direct comparison of the 12-inch Gun, Model 1888, and the 16-inch Howitzer, Model 1920, shows the progress in the construction of built-up guns; and the 3-inch antiaircraft guns are used to illustrate manufacture by the process of cold-working. A practical exposition of breech mechanisms, firing mechanisms, and subcaliber guns, together with a brief explanation of the manufacture of this type of matériel, completes the instruction in this subject.

Recoil and recoil brakes, difficult to understand from either the theoretical or the descriptive viewpoint, are discussed as a preliminary to the topic of artillery. As this latter subject is very important to the line of the Army and as all officers should have a good general knowledge of artillery matériel in service, the various models of artil-

lery are enumerated and a reasonable number of types studied in detail. Great effort is made to teach the cadet the principles and mechanisms involved in the matériel, rather than insisting on the mere nomenclature of models and pieces. For example, the cadet is required to *understand* and indicate the various parts of the gun and carriage that take up the stresses of firing and to show how the force of recoil is finally dissipated. He is required to understand the action of gears, worms and cams, the hydraulic brake, the Waterbury hydraulic speed gear, the mechanism of the various safety devices, etc. By this study of mechanisms, principles are learned; and these same principles apply equally well to any other piece of ordnance with which the cadet may later come in contact.

The aiming and laying instruments together with the fire-control apparatus necessary for directing fire are studied in connection with artillery.

The probability of hitting the target and the adjustment of fire, are subjects which hold a real fascination for the student of things military. By the time a cadet becomes a first classman he has already mastered a course in mathematics which goes deeply into the theory of probability. In ordnance the theories are used to show the chances of hitting a target under many varying and rather obscure conditions.

Projectiles, primers, and fuzes are treated almost entirely from the practical viewpoint. The cadet becomes familiar with the more important types of projectiles and must understand the mechanism and operation of the principal primers and fuzes used in the service.

THE new cadet's first impression of West Point probably refers to the position of his shoulders and his chin. His second impression probably has to do with his rifle. The rifle becomes his constant companion which he carries and nurses every day of his four years, unless he has the good fortune to become a cadet officer during his first class year and displaces his gun by his sword.

But the cadet, in spite of his close relationship with his rifle, fails to grasp the true significance of the cams and lugs and screws. Until he reaches the small-arms part of the course in ordnance, he is in much of a daze regarding the whys and wherefores of the weapon with which one would think he had become entirely familiar. In the course in small arms and small-arms ammunition, attempt is made to impress upon the cadet the importance of knowing all there is to know about the operation, construction, care, power, possibilities, and limitations of the weapon with which the greater part of the Army is equipped.

Machine guns and automatic rifles are not treated in quite such detail. But the service automatic weapons are described and discussed, and the possibilities of the semi-automatic shoulder rifle presented.

The very new subject of motorized matériel, as applied to ordnance, is introduced. As this type of matériel has not become standardized but is still very largely in a highly developmental state, the course consists essentially of a discussion of the history of artillery tractors, tanks, and self-propelled gun mounts, with a discussion of the most recent developments and experiments made in the field.

Cadets Receiving Instruction at Aberdeen Proving Ground.

Hand grenades, used extensively in the 15th and 16th centuries, became practically extinct in the 19th century. However, they have been used from time to time when special occasion demanded, as at the siege of Port Arthur in 1905 and during the World War, after the armies became entrenched on the western front. So the grenade is with us and was an important element of the last large munitions program undertaken. The types adopted as standard during the World War are included in the course of instruction in ordnance, but interest in the grenade will probably decrease from year to year as new types of ordnance are developed and the experiences of the last war move further and further in the background.

A special course in ordnance theory and design is arranged for cadets of the upper sections, who are able to proceed more rapidly than the average cadet. This course consists of a study of the forces brought upon the principal parts of gun carriages, and the design of parts to withstand the stresses developed. General Ruggles' excellent text, "Stresses in Wire-wrapped Guns and in Gun Carriages" is the text used for this part of the course which is true ordnance engineering.

ONE very important feature of the course in ordnance is that practical demonstrations are made wherever possible. The splendid Ordnance Museum at the Military Academy is utilized to a great extent and models of barbette, disappearing, and antiaircraft artillery are examined and operated by cadets. Chronographs of the Le Boulengé and Aberdeen types are set up, a rifle is fired, and velocities are actually recorded. Samples of all types of propellants and high explosives are available in the recitation

rooms; and sectionalized rifles, pistols, machine guns, and automatic rifles are used in the explanation and demonstration of small arms. Actual fuzes and grenades, standard and sectionalized types, are on hand, and an attempt is made to develop the cadet's interest in the material with which he will come in contact by requiring him actually to see and handle as many articles as may be made available.

PERHAPS that part of the course which is really enjoyed by the cadets is the practical instruction in machine shop work conducted at the Ordnance Laboratory. This is a very brief course in practical metal working. In the shops at the laboratory there are installed lathes, milling machines, planers, grinders, benches and vices, a turret lathe, an engraving machine, forges, gas furnaces, pyrometer equipment, a drop hammer and a trimmer. In eleven laboratory periods of two hours each, the cadet is required to perform operations on most of these machines and to take part in demonstrations on those that he does not actually operate.

The cadet approaches his job on a machine not from the point of view of the high school student taking manual training and wishing to turn out "something" that is complete, but from the more mature viewpoint of trying to learn as much as he can about metal working in the very limited time at his disposal. He is cautioned to pay particular attention to: (a) the construction of the machine on which he is working, the methods of control, the manner and mechanisms by which electrical power does the work required; (b) the order or sequence of operations; (c) the time required to produce satisfactory metal articles; (d) the greater time and effort required to produce an article to a close dimension than to a dimension having wide tolerance; (e) the amount of skill required to produce a really acceptable piece of work.

The cadet is given typewritten instructions as to how to proceed and what steps to follow but is urged to analyze the steps and be sure that he comprehends the whys and wherefores of his operations.

Many cadets never have attempted to cut metals and many never have been in a machine shop, though a large proportion have taken some type of manual training at high school. This practical course is essentially different from any other work taken at the Military Academy and frequently gives the cadet his first vision of the broad field of metal manufacture. He begins to understand that the parts of his surveying instrument, of the truck on which he rides to drill, of the French 75-mm. gun which he shoots, of his rifle—do not merely "happen," but are the result of long hours of planning and engineering and careful effort on the part of machinists and operators over forge and lathe and milling machine and drill press. The value of the course cannot be underestimated as it gives the cadet his first real insight and interest into the whole subject of metal manufacture.

Lectures are introduced to vary the monotony of section room work and to give new angles to old work, to get some one's personal slant on a subject, to get a view that is broader or cannot be included in a text. So the lectures will embrace such topics as antiaircraft fire control, artillery of today and tomorrow, small-arms development, the preparation of saluting charges (so frequently one of the second lieutenant's early duties—and dangerous), ordnance pamphlets and publications, industrial preparedness for ordnance, etc.

AS a fine climax to the year's work in ordnance, the entire class is taken to Frankford Arsenal and Aberdeen Proving Ground to see demonstrations and make an inspection of these establishments. A carefully prepared program is followed at the arsenal and at the proving ground, the scope of the instructional work being something like this:

At Frankford Arsenal.—An opportunity is afforded to inspect a modern manufacturing plant, to observe the general arrangement and control of such an establishment, and specifically to study the methods of manufacture of small-arms ammunition, fuzes, and other matériel in production. The cadets, in sections, are conducted through the plant and the planning, routing of work, method of inspection, and details of operations are carefully explained. The cadets leave the arsenal with a greater knowledge and better viewpoint of mass manufacture.

At Aberdeen Proving Ground.—The cadets witness firings from field guns from the small calibers to the 240-mm., from guns on self-propelled mounts, from antiaircraft guns on fixed and automobile mounts, from railway and seacoast artillery up to 16-inch caliber; they witness tests and maneuvers of tanks and tractors, both service types and experimental; examine various small arms, semiautomatic weapons, caliber .50 machine guns, etc.; see demonstrations of bomb dropping from airplanes and examine the effects of the explosion of bombs. An inspection is made of American and foreign ordnance matériel, including particularly automotive equipment and large guns. A careful explanation is made by proof officers prior to each demonstration; and, in addition, officers and civilians in charge of the different activities at the proving ground, give short lectures on the development and experimental work in progress. The demonstration is really an abridged edition of "Army Ordnance Day" with a little more explanation and a little less demonstration.

The educational value of this trip to Frankford and Aberdeen is very great and permits the cadet to witness firings and demonstrations which many of them would not have an opportunity to see in many years of regular service.

These are the things we try to accomplish. These are the opportunities which a cadet is given to acquire a basic knowledge of the theory and practice of ordnance. Some cadets derive the full benefit of it; some absorb none too much; but all gain an appreciation of the problem of ordnance and of its exceptional importance to the Army.

What Are The Oldest Military Powders?

Modifications of Composition Since the Battle of Crecy

By Louis Desvergnes*

WITHOUT going back to the Romans who, in the fourth century[1] were already familiar with fireworks, to the Greeks of Constantinople who, in the seventh century[2] were already making extensive use of pyrotechnics, to the Arabs[3] and to the Chinese,[4] it will soon be six centuries since cannon powder first appeared on the field of battle (Créey, 1346).[5]

Since then black powder has been manufactured regularly for fire arms. It would be interesting to know the successive modifications that it has undergone and to be able to compare samples of various epochs. Unfortunately, on account of the attendant dangers, it is rarely that military powder has been preserved in considerable quantities by private individuals since they kept only such quantities as would supply their immediate needs.

In the arsenals, for obvious reasons, powder has always been consumed by using the oldest stocks first; the remainder of stocks that have become too old have been the object of systematic demolitions when they were not destroyed by accident. For all these reasons, one can see how samples of old powder are of great rarity.

We have, however, found some and they are perhaps the oldest military powders that are in existence. In order to prove their anthenticity we explain under what circumstances they came into our possession; then we will give the results of their examination which seems to us to be of unquestionable interest.

In 1905 in the course of excavations made on the public place of Saint-Martin-de-Ré (Charente-Inférieure), there were found trenches where lay some human skeletons probably some of the defenders of this city besieged by the English in 1627. In the midst of this debris there was picked up a spherical shell containing a damp black powder. Thanks to the kindness of Mr. F. Moreau, President of the Commission of Public Works of Saint-Martin-de-Ré, we have been able to have a sample. Here are the results of the analysis made at this time:

After dessication at 110°, the powder, of blackish color, burned quite readily in contact with flame. A chemical analysis gave:

Saltpeter	31.9	Charcoal	31.4
Sulfur	19.5	Ferric oxide	17.2

*Chemical Engineer, Poudrerie Nationale de Sorgues, France. Reprinted, by permission, from Revue d'Artillerie. Translated by John Huling, Jr., Captain Ordnance Department, U. S. Army.

1Claudianus (Claudius), De Consulatu Fl. Manlii Theodori Panegyris (399 ap. J.-C.). Julius Africanus. VII.

2Lalanne (Ludovic), Recherches sur le feu grégeois et sur l'introduction de la poudre à canon en Europe (Paris, 1845).

3Toward the end of the thirteenth century, Arabian texts speak of powder. Nedjm-Eddin-Hassan-Ahdab, who died in 1295, gives three receipts collected by his ancestors:

Baroud (saltpeter).....	10 drams	10	10
Sulfur	1	1¼	1⅛
Charcoal	2	2½	2¼
which give respectively:			
	76.90	72.72	74.79**
	7.69	9.09	8.38
	15.41	18.19	16.83

**Note by translator: Typographical errors in this column corrected after correspondence with the author.

4The Chinese had established relations with the Romans and were engaged in commercial activities on the Red Sea up to the seventh century; it is probably from them that Callinique got the Greek fire. They used cannon powder in 1232 at the siege of Caifong-Fou (Mailla, Histoire générale de la Chine, IX, et Quatremère, Histoire des Mongols, I). It is noted that we should say "feu grec" but we have retained the word "grégeois" as Joinville wrote it.

5It is through error that the invention of powder has been attributed to the German Monk Berthold Schwartz (1310-1384). He discovered the art of casting bronze cannons and established a workshop in Venice in 1377. He was put to death by the Venetian Senate for having insisted on being paid . . . . in the fourteenth century they had the art of cutting short the complaints of creditors.

Let us call attention to an error on the subject of the Monk Schwartz. In his work on Greek fire and cannon powder, Lalane says, page 85 (note): "At the Uffizi museum in Florence, there is preserved a picture dating from the latter part of the fifteenth century by Giacomo Crespi, which represents the German Monk in his laboratory where he is engaged with many workmen in the making of powder. One reads on the mortar this inscription: 'Pulvis excogitatus 1354 Dania Bertholdo Schwartz'."

This assertion is absolutely false for by a letter of March 21, 1928, the director of the Galleries and Museums of Florence has informed me that this picture is unknown in the Uffizi Gallery.

This oxide came from the metal of the shell which had rusted in contact with the damp earth and was mixed with the powder when the shell was emptied.

If one takes account of the ferric oxide accidentally added to the powder, one obtains for the powder alone, the following composition:

Saltpeter	38.5
Sulfur	23.5
Charcoal	38.0

It must be concluded that during two hundred and seventy-seven years stay in the earth, water had carried away a large part of the saltpeter.

Furthermore, the composition of ancient English cannon powder was as follows:

Saltpeter	75
Sulfur	10
Charcoal	15

In taking account of the proportion of saltpeter dissolved, which would be 36.5, one should find by analysis:

Sulfur	24.5*
Charcoal	37.0

which corresponds very well to the figures found above.

In a recent[6] work, the author mentions the analysis of this powder quoted in an Italian work which moreover, does not mention its source.[7] In reading this work we got the idea of undertaking the analysis of this specimen in a more complete fashion.

The powder being made up of the powder and lumps (paradoxicality of the French language) it was sieved so as to work on only the blackest powder. After dessication for forty-eight hours in a vacuum over sulfuric acid, the analysis gave:

Saltpeter	27.01
Sulfur	19.69
Charcoal	26.54
Ferric oxide	26.76

*(Note by translator): In other words, the figures found above are approximately those gotten by adding together the percentages of sulfur and charcoal obtained by omitting the iron oxide and multiplying by the theoretical proportions of sulfur and charcoal in English powders, thus:

$$\begin{array}{r} 23.5 \\ 38.0 \\ \hline 61.5 \end{array} \qquad 61.5 \times \frac{10}{25} = 24.6 \text{ (sulfur)}.$$

$$61.5 \times \frac{15}{25} = 36.9 \text{ (charcoal)}.$$

6Pique (R.), "Black powder and the powder services." (Paris, 1927.)

7Molinari (E.) and Quarteri, "Review of Explosives in Italy."

In taking account as above of the ferric oxide, one finds the following:

Saltpeter	36.87
Sulfur	26.19
Charcoal	36.94

The pulverized part of the powder is therefore as much contaminated with the iron oxide as the brown lumps.

Examination of the separate constituents:

1. Charcoal, color black, burning point 430°.

2. Sulfur, color lemon yellow, melting point 113.3°. This sulfur is pure.

3. Saltpeter—It has the following composition:

Calcium nitrate	0.76
Sodium chloride	0.63
Calcium sulphate	0.30
Potassium nitrate	98.31

This potassium nitrate is not very pure, but the impurities may come from the water by which it has been contaminated.

Having asked in 1924 in *l'Intermédiaire des Chercheurs et Curieux*[8] if in France or in foreign countries, any private individuals or museums possessed any old cannon or musket powder, the responses to this question were not numerous.[9] One correspondent reported that the Lorraine Historical Museum of Nancy possessed a block of black powder dating from the seventeenth century. One other correspondent, Mr. Louis Capet, of Neuilly-Plaisance, replied that he possessed some cannon powder preserved in his family since the time of his paternal grandfather who had served in the armies of Napoleon I and had made the campaigns of Spain, Germany, Austria, and Russia. This grandfather had retired to Montreuil-sous-Bois where his family had already settled under Louis XIV.

As to the older of these two powders, thanks to the very obliging assistance of Mr. Demeufve, the custodian of the Lorraine Historical Museum, we got a sample of it and also its history of which we give a resumé below.

In 1878 there was discovered under the roof of the church of Chatel-sur-Moselle, two muskets, some musket barrels, four loaded shells, a match and a block of powder weighing about one kilogram. This block is catalogued in the Lorraine Museum under the number 1205.

An examination of these arms shows that we have found a deposit made in the first half of the seventeenth century, something which we may well associate with the fact that under the reign of Charles IV, Duke of Lorraine, Chatel

8Intermédiaire des Chercheurs et Curieux (Paris, 10 février 1924).

9Intermédiaire des Chercheurs et Curieux (Paris, 10 mars 1924).

sustained many sieges in 1636, 1637, 1641, and 1650.

This powder consisted of both lumps and powder of a black color.[10] The lumps are not composed of compressed powder, but instead of powder agglomerated by time and dampness. When it is broken open, the interior shows white efflorescence due to saltpeter. The water content determined in vacuum is 00.74 per cent.

The powder thus dried burned on contact with a strong flame. A chemical analysis gave the following results:

Saltpeter	84.50 per cent
Sulfur	4.81 per cent
Charcoal	10.69 per cent

After sifting, a second analysis made on the pulverized part gave:

Saltpeter	83.63
Sulfur	5.33
Charcoal	11.04

These two analyses show an odd composition for this powder, too poor in sulfur and too rich in saltpeter. This anomaly may only be explained by an enrichment of a part of the powder in saltpeter by means of saltpeter originally contained in the rest of the powder and dissolved by moisture from the air.

This hypothesis seems to be well supported by the presence of the white efflorescence due to the crystallization of saltpeter.

If it is assumed that the powder in question was of the proportions:

Saltpeter	75
Sulfur	10
Charcoal	15

and that it was enriched by 60 per cent of saltpeter carried in by moisture, one would get the following composition:

Saltpeter	84.37
Sulfur	6.25
Charcoal	9.38

The formula adopted in France[11] was:

Saltpeter	75.0
Sulfur	12.5
Charcoal	12.5

This formula was used both for cannon powder and sporting powder; for the latter there was used a saltpeter, better refined, a purer sulfur, and a lighter charcoal.[12]

Examination of the ingredients.

1. Charcoal, color, black.

Burning point, 428°.

This charcoal had been prepared by carbonization about 450°.

2. Sulfur, color, pale yellow.

Melting point, 118.5°.

3. Saltpeter, its percentage composition is the following:

Calcium nitrate	0.76
Chlorides	traces
Potassium sulphate	1.45
Potassium nitrate	97.79

This saltpeter is impure; the refining is therefore very defective. It was, moreover, only in the second half of the eighteenth century that it was known how to purify saltpeter and to obtain what was called refined saltpeter or triple boiled.

This is the manner in which it was prepared in the eighteenth century:[13] The leach water from saltpeter earth was put in a hemispherical copper boiler, the insoluble matter was lifted out mechanically, then it was concentrated by boiling.

At a certain point some Flemish glue was added and it was carefully skimmed. During the evaporation there was formed on the surface of the liquid, a pellicle which precipitated itself to the bottom of the boiler. This was the "grain" (sea salt), and was removed with a skimmer.

To find out the degree of evaporation, from time to time, a few drops were allowed to fall on a cold body: one judged the degree by the quantity of crystals that were formed.

Then the solution of saltpeter was emptied into large copper basins with wooden covers and put in a cool place. One succeeded in getting a well refined saltpeter by a decantation from the grain between the emptying of the boiler and the crystallization in the basins.

Let us pass now to a recent period, that of the First Empire. Mr. Capet having had the graciousness to give up his family souvenir, we have been able to have at our disposal a somewhat large quantity of this cannon powder.

Let us note in passing that formerly, soldiers, coming from the country, took away with them at the time of discharge a certain quantity of powder. It entered into (along with soot and grease) a popular remedy designed to cure bloat in cattle.

10Desvergnes (Louis), Examination of a seventeenth century military powder found in the church of Chatel-sur-Moselle in 1878 (Bulletin de la Société Archéologique Lorraine, April-June 1924).

11To prepare powder in France there was used:
76½ pounds saltpeter refined, and dry.
12½ pounds of charcoal.
12½ pounds of sulfur.
(Surirey De Saint-Remy, Mémoires d'artillerie, Volume II, title 10, second edition, Paris, 1745).

12Le Blond, L'Artillerie Raisonnée, art. V (Paris, 1776).

13Théodore Duturbie, Manuel de l'Artilleur, containing everything which is necessary for officers and non-commissioned officers of artillery to know, approved by Gribeauval. 4th edition (Paris, year II of the République).

The results of the examination of this powder are given below:[14]

1. Physical examination—this powder is in spherical grains (again the paradoxicality of our language) and little angular chunks of a dull black color.

Number of grains to the gram	4.080
Gravametric density	0.911
Absolute density	2.423

If we examine separately the grains and the irregular chunks, we get:

	Spherical Grains	Irregular Chunks
Proportion	15 per cent	85 per cent
Diameter	0.7 to 1.5-mm.	0-5 to 1.5-mm.
Absolute density	2.040	2.486

2. Chemical examination—the humidity determined in vacuum is 1.72 per cent.

The material thus dried gives the following results upon analysis:

	Spherical Grains	Irregular Chunks
Saltpeter	75.26	75.23
Sulfur	11.59	11.70
Charcoal	13.15	13.07

This composition corresponds obviously to that prescribed for cannon powder.

Saltpeter	75.0
Sulfur	12.5
Charcoal	12.5

Examination of the ingredients:

(1) Charcoal—color		black
	Burning point	430°
(2) Sulfur—color		lemon yellow
	Melting point	113.4°
(3) Saltpeter—the percentage composition found is:		
	Calcium nitrate	0.11
	Chlorides	traces
	Sulphates	absent
	Potassium nitrate	99.89

This saltpeter is then very pure: the refining was very careful during the revolutionary period.

Continuing the search for samples of old powder, we have just made an inquiry among the principal museums of France and the results are negative. Alone, the Musée des Canonniers Sédentaires of Lille possesses some rare specimens of reed friction primers; but we do not know the exact date of these primers, the model of which was in use up to 1840.

This is the manner in which primers were prepared at the end of the eighteenth century:[15] cotton wicks were soaked in vinegar twenty-four hours, then they were rolled in the following composition:

Brandy	½ pint (465.5 cm.)
Saltpeter	½ pound (244.5 gr.)
Priming powder	1 pound (489 gr.)

After pressing between the fingers to expell the excess of the paste, they were rolled in priming powder and allowed to dry.

We wish to express here our sincere thanks to Mr. Em. Théodore, general custodian of the Musées du Palais des Beaux-Arts of Lille, who had the great kindness to furnish us with information on the Lille museum and to put at our disposal the four works of the eighteenth century treating of artillery, works which were a part of his personal library and which libraries generally do not have.

May this article have the good fortune to put us on the trail of some new samples of old powder, thanks to the kindness of some reader.

14Desvergnes (Louis), Examination of a cannon powder of the First Empire (Annales de Chimie analytique, 15 mai 1924).

15Mr. de Scheel, Mémoires d'Artillerie, containing the new artillery or changes made in the French artillery in 1765 with the explanation and analysis of the objections made against these changes, 2nd edition (Paris, year III of the Republic).

Walter C. White

THE Cleveland Ordnance District lost one of the outstanding automotive authorities in America when Mr. Walter C. White, President of the White Motor Company, died September 29, 1929. As chief of the Tank, Tractor and Trailer Division of the District, he was most active in the affairs of the District having aided in the war production plans of ordnance automotive matériel.

A pioneer in the motor truck industry and a recognized authority on automobile transportation, Mr. White was born in 1876, the year in which his father, the late Thomas H. White, organized The White Sewing Machine Company as successor to The White Manufacturing Company. He was graduated from Cornell University in 1898 and later from the New York Law School. Admitted to the New York State bar, he spent several months in the legal department of the New York Central Railroad and returned to Cleveland in the fall of 1900 to continue the factory training started during his summer vacations from college. From 1901 to 1904 he sold "White Steamer" passenger cars in Europe as London manager for the company and was in the driver's seat in many of the first road tests of automobiles.

Soon after the start of the World War Mr. White was appointed chairman of a committee to go to France and assist in organizing the repair and maintenance of motor vehicles in military transportation. A groupment of 2,500 of the Allied war fleet of 18,000 White trucks was awarded the Croix de Guerre for distinguished service by the French government which also conferred upon Mr. White the highest honor it can give a civilian, making him a Chevalier of the Legion of Honor.

The second and third generations of the White family direct the White Motor Company (the manufacturing organization) and The White Company (the sales organization), as well as the subsidiary White Motor Realty Company and The White Motor Securities Corporation. Walter C. White was President of these companies.

"Cleveland has lost an outstanding citizen," a statement by President Allard Smith of the Chamber of Commerce said. "It's industry and business loses a great leader. Walter White was always ready to support generously with his time, thought and finances every worth while community endeavor. His delightful personality and true friendship we shall ever cherish."

The Power to Commandeer

Useful as a Threat, Least Valuable When Exercised

By George L. Shearer*

THIS subject has its military aspect and its civilian aspect. In any emergency it will be necessary not only to commandeer articles for military use but it will also be necessary to commandeer other articles in order to protect the civilian population, for any interference with the well-being, cost of living, or morale of the civilian population is going to have a direct and indirect, and in both cases, an unfavorable effect upon the conduct of military affairs. The commandeering of articles to protect the civilian; the fixing of prices; the allocation of raw materials, and the issuance of priorities are all means by which virtual, if not actual, commandeering can be accomplished. But, as I see the matter before us, it is not necessary for us to discuss anything but the military side of the subject except as the other side is incidentally involved.

The power to commandeer in a military sense has to be considered in two aspects: first, the power of Congress, and second, the power of the President independent of Congress.

So far as commandeering is concerned, the provision which occurs to everyone in this connection is that no man shall be deprived of his life, liberty, or property without due process of law. Learned writers and courts have discussed the question and they are not in agreement as to whether the exercise of such a war power as that of commandeering involves a breach, or at least a suspension, of constitutional guaranties, or whether the power to take steps essential to the national defense exists at all times and is at all times paramount to the constitutional provisions, or whether the other provisions of the Constitution, such as the one which empowers Congress to declare war, gives an implied authority to Congress and the Commander-in-Chief of the Army and Navy to take all steps necessary to carry a war, once declared, to a successful issue.

These three views are only important to a rational system of jurisprudence. Practically it makes no difference to us whether or not in this respect the Constitution is violated, sustained or disregarded.

It is a fact that the power to commandeer in proper cases has been upheld by the courts as not violative of the Constitution. It is the settled law that Congress can, by its acts, authorize commandeering in time of war. It is not unlike the power of condemnation which is inherent in every sovereign, the power to take private property for public use upon the payment of just compensation. This power is legislative, not executive. It lies dormant until the legislative body acts. It cannot be exercised by an executive without legislative authority. Even the Supreme Court of the United States has slipped up in a couple of cases and has talked about the executive exercise of the power of commandeering as an exercise of the power of condemnation. But, as far as Congress is concerned, if we can find legislation which authorizes an executive or any governmental agency to exercise the right to commandeer, no further difficulty arises.

DURING the last war, there were many acts passed which authorized limited commandeering. The only one which remains on the statute books at the present time is Section 120 of the National Defense Act, which authorizes the President in time of war, or when war is imminent, to place an order for any product required and which is of the nature usually produced by the manufacturing industry with whom the order is placed. Subsequent language in this Act seems to limit the articles to be produced to arms, ammunition and necessary supplies or equipment for the Army. Then follow provisions for commandeering the plants refusing to execute such orders and operating such plants through the Ordnance Department. The language used in this Act gave rise to the question as to whether it authorized the President to commandeer articles already manufactured, and that question so far as I know, though discussed at length by the Government's legal talent, has not been settled by the courts. Many other acts which no longer are on the statute books authorized commandeering of ships, dry docks, warehouses, foods, feeds, fuel, mines, taking over telegraph, telephone and cable lines, operating railroads and many other things. Altogether, there was a hodgepodge of legislation which gave rise to immense confusion, lack of coördination and conflicting actions by the Army, Navy and other governmental agencies.

It is here that the first important thought occurs to us. When war threatens, or after war is declared, to wait for congressional action causes confusion and embarrassment and interferes with the conduct of all operations. Now is the time, when there is no cloud upon the horizon, to urge upon Congress the passing of one comprehensive and effective act authorizing the governmental agencies to do all those things, when war threatens, which the last war has shown to be necessary in a major emergency. We doubt if the War Department has sufficient vision to suggest an act that will be sufficiently comprehensive, because it must embrace both military and civilian affairs. It should be prepared by joint action of the Army, Navy and heads of industry, but it should be placed on the statute books in time of peace and it should be done now, before the lessons of the last war are forgotten and before those who were principal actors on the scene and learned those lessons have disappeared. It is as necessary that this be done as it is to have an adequate war reserve of arms and ammunition. More of this later.

The other side of the power of commandeering involves consideration of the power of the President to commandeer. So far as this is conferred on him by congressional legislation, there can be no question. So far as this power can be exercised by him without congressional legislation, there has been endless discussion. There is also the question of the exercise of this power by other governmental agencies

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and by commanding officers of military forces. The courts have not been consistent when they have tried to define the limits for the exercise of this power. The sole basis is that of necessity. This seems clear enough, but when it comes to consideration of special cases, confusion at once arises. There are two kinds of cases that stand out: one where property is taken summarily for use and where the owner is entitled eventually to compensation either by court action or by the action of a board of appraisers or of the President, and the other class of cases where property is destroyed and the owner is entitled to no compensation. Such a case may arise where buildings or supplies must be blown up to prevent them from falling into the hands of the enemy. This is not different from a case where buildings must be destroyed to prevent the spread of a conflagration. The owners are entitled to no compensation. The only thing that can be said about the decisions of the courts in these cases is that each case must be decided upon its own peculiar facts.

Much of this confusion will be removed by the proposed comprehensive legislation passed in time of peace, to which we have referred.

WE can now consider briefly what occurred during the World War. The most noticeable thing that occurred was confusion. The Army commandeered material needed for the Navy. The Navy commandeered material needed for the Army. Someone tried to commandeer a house in Washington to establish a club with fifteen bedrooms! There was an utter lack of coördination. That, it seems to us, is the great lesson taught by the war in this respect. Towards the end of the unpleasantness, the War Industries Board asked the President to order all commandeering activities to be approved by that Board. This was not done, but the President did request that no commandeering orders should be issued without consultation with that Board. This request had the effect of an order and thereafter there was less confusion and if the war had continued, it is probable that commandeering activities would have been adequately coördinated.

As to commandeering in future emergencies: we have pointed out the necessity of comprehensive enabling legislation. This is first and most important. In this connection there should be a warning. It is at least suggested that all of this work should be under control of the military authorities. As we see it, this would be extremely unwise. So far as those suggestions have been worked out, it has been recognized that it may become necessary in an emergency to have some superagency to effect the coördination and to provide for some nonmilitary operation and supervision of some plants and activities. If such a superagency may become necessary, the provision for such a superagency should be enacted in advance. It should not be left to be created after the military agencies fail to function. You cannot run big business with military discipline. The subordinate in business should be able to chide his superior without being court-martialed. Unquestioned obedience, inability to assume responsibility, the necessity of punctilious attention to superior authority has often little or no place in business affairs. To attempt to introduce military formalities into a going business with the inevitable delay and lost motion will be fatal. The superagency can be so constituted as to be representative of all branches of the service and of all industry, and when properly constituted, it can function smoothly and insure coordination. This may not be a welcome suggestion because necessarily a person with military training is like a pedagogue, we inclined to be disdainful of opinion and capacity of others.

So far as the Ordnance Department is concerned, forgetting all these general considerations, what should be done in the event that a manufacturing plant is commandeered and under existing legislation that plant is to be operated through the Ordnance Department? One of the first things to be done is to see that a correct inventory is made of everything that has been seized. Without such an inventory, the question of compensation to the owners is one that never can be solved. The next question is how to run the plant. In our opinion, as many of the people connected with that plant as possible should be retained. No one should be discharged merely because he has refused to carry out the orders of the President, the result of which refusal has been the commandeering of the plant. He may have to be watched, but his knowledge is an asset that should not be lost. Of course this cannot always be done but at least it should be tried. To try to run a manufacturing plant with people who do not know the plant is like trying to operate the engine room of an ocean liner with competent engineers who have no diagrams. The less the Ordnance Department meddles, the less it atttempts to enforce its own ideas, the greater should be the success of its operations. The ordnance officer in charge must understand something of how little he knows. It is certain to be no easy task in any case, but watchfulness and prayer will be better than interference.

The last consideration to which we want to call attention is that of compensation to the person whose property is seized. Various methods were tried during the last war. There was a board of appraisers for some cases. In other cases the President fixed the compensation. If it was not satisfactory the owners could get 75 per cent of the compensation so fixed and sue the Government for the difference. Until the whole world is composed of reformers, there will always be disputes over compensation in these cases, but the important subject for our consideration is the fixing and prompt payment of this compensation except in the cases where no agreement can be reached. No board of appraisers sitting in Washington can handle this question with sufficient expedition or with sufficient knowledge. The moment that a plant is commandeered the compensation should be determined. This could be done locally by disinterested persons familiar with the business involved appointed for that case only, who should act promptly and whose determination when made should be accepted as often as possible by the Government without question. It is of small consequence whether the Government pays a little too much so long as it pays it promptly. People dealing with the Government in these emergencies must be treated fairly. Just and speedy compensation will tend to keep the good-will of the citizen. It will tend to reduce the cases where commandeering will be necessary, for, after all, as a final consideration, the power to commandeer is most useful as a threat and least useful when exercised.

ARMY ORDNANCE

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Month by Month

READERS of ARMY ORDNANCE will regret to learn of the resignation of Maj. Chas. R. Baxter as Executive Secretary of the Army Ordnance Association and Editor of this JOURNAL. Due to the fact that Major Baxter was able to devote only a limited amount of his time—and that after hours—to the Association, he felt it necessary to tender his resignation. In accepting the resignation, Hon. Benedict Crowell, President of the Association, wrote, on behalf of the Board of Trustees:

Secretary-Editor Changes

"It is with a great deal of regret that I, on behalf of the Board of Trustees of the Army Ordnance Association, accept your resignation contained in your letter of October 14th, as Executive Secretary of the Army Ordnance Association and Editor of ARMY ORDNANCE.

"I appreciate the added burden these offices have been to you particularly since they are not a part of your duties in the Ordnance Department where your entire time is occupied. Under these conditions it is all the more remarkable that you have conducted the affairs of the Association so successfully.

"Please accept my own personal thanks and those of the officers and directors for your splendid coöperation. In this I am sure that the entire membership has the same sentiment."

Upon the recommendation of the President and with the approval of the Board of Trustees, as provided in Article IV of the Constitution of the Association, Capt. L. A. Codd, Ord. Res., who has served as Assistant Secretary and Associate Editor for several years, has been elected Major Baxter's successor.

MEMBERS of the Army Ordnance Association should take pardonable pride in the success of the Eleventh Annual Meeting of the Association at the Aberdeen Proving Ground on October 10th. It was the outstanding gathering of the year, not only because of the extensive program of tests and demonstrations, but particularly because of the large numbers of executives and engineers who were in attendance led by many high officials of both defense services of the Government.

Our Aberdeen Meeting

It may not be inappropriate in discussing this latest meeting of the Association to allow our minds to go back twelve or thirteen years when preparedness demonstrations were the vogue. In those days it was necessary to conduct extensive campaigns in the interest of adequate national defense. The popular mind for the most part has reverted to the same attitude which characterized the early war days. At Aberdeen thirteen years after the first impetus, there was still gathered a valiant band to perpetuate the earlier ideals. This in itself is significant. But the predominant note of the meeting has always been, as it was in an added degree this year, scientific and educational.

The Aberdeen meeting of the Association is no military circus; it is no "sweethearts on parade" affair. It is a serious business, as serious as any that could claim attention. In evidence of this, witness the presence of outstanding engineers, manufacturers and industrialists; witness the engineering nature of the demonstrations themselves; witness the technical aspect of the discussions and papers presented. That the press emphasizes from year to year the novelty of the exhibits is no criterion for that is only half the story. The fact is the meeting is above all educational, and is intended primarily for industry—the peace industry of today which must be the war industry of tomorrow if the morrow requires it.

Thus the Eleventh Annual Meeting takes rank with its predecessors in having carried on a vitally important work. May its successors be conducted on the same educational plane and carry the ideal to even greater heights so that industrial preparedness may continue to be the real live thing its devotees claim it to be. Such an impetus as our annual meeting gives this cause is more than helpful, it is necessary to our modern concept of the industrial aspect of national defense.

TO call the roll of eminent leaders—military and civilian—who in the economic prosecution of the World War played their parts in as masterful fashion as any tactician in the field, would be at this late date a twice told tale. The literature of the period is replete in its accounts of their activities, and their work will ever be an integral part of the history of those days. Foremost among them is the name of Hugh S. Johnson who held unusually important assignments connected with the mobilization of both men and material. General Johnson, by reason of his World War experience and his professional and industrial activities, is admirably qualified to appraise the merits and demerits of any major plan involving the economics of the prosecution of war.

Keeping an Even Keel

His paper in this issue of ARMY ORDNANCE in which he discusses the fallacies of the so-called universal draft and proposes, in lieu thereof, an equitable and efficient plan for the mobilization of industry in war, is at once logical and convincing. What General Johnson has to say is not based on a flimsy naive appeal to the popular imagination, and no basic plan of procedure for so vital an undertaking should be. Like Scott, Willard, Crowell and Baruch, Johnson lived through the trial by ordeal when the harnessing of America to the prosecution of war—"without stint or limit"—was the great problem of the day. His theories,

his weighing of values and means are backed with more than logic, they are based on experience and as such should carry conviction.

We realize, of course, the value of debate on such a topic. We know that there are many sincere individuals who hold the universal draft to be the only equitable solution in war. Admitting the sincerity of such individuals, they are, of course, entitled to their viewpoint. But for all this, the practical should not be forgotten and theory should not be allowed to run away with fact. Viewed calmly and interpreted fairly, we must confess the logic and practicability of General Johnson's thesis, and conversely we must admit that we fail to see anything but pitfalls, fallacies, and even unconstitutionality in the "draft everything" theory.

General Moseley's Appointment

SINCE the last issue of Army Ordnance an appointment of unusual significance to the cause of industrial preparedness has been made in the detail of Brig. Gen. G. V. H. Moseley to the office of The Assistant Secretary of War. In announcing the detail, The Assistant Secretary, Colonel Hurley, emphasized that the statutory and delegated duties of the Office of The Assistant Secretary of War have become so numerous and important that it is essential for him to have an executive with the rank of a general officer for the purpose of coördinating the various activities, conducting conferences with the numerous Chiefs of Bureaus and civilian components, and in preparing concrete and thorough analyses of the various important questions for decision of The Assistant Secretary of War. The position requires an officer who is thoroughly experienced and qualified in the great problems of procurement, in the administration of military affairs and in the special problems connected with the civilian components of the Army.

General Moseley is outstanding in all of these requirements. Throughout his service he has been distinguished for his efficiency and professional attainments. During the World War he was head of the Supply Section of G. H. Q. overseas and thus obtained experience rarely afforded an officer. He acquitted himself with notable distinction. Since the war he has been intimately associated with the civilian components and in the conduct of training camps where his success is well known. During the last five years he has commanded successively the Hawaiian Field Artillery Brigade and the First Cavalry Division, thus bringing him intimately into contact with troops and with the needs of the military establishment both in the continental United States and overseas. During the recent disturbances on the Mexican Border his tact, sound judgment, resourcefulness and fearless assumption of responsibility were responsible, in a large degree, for the lack of friction and the favorable termination of the insurrection as it affected the Border situation. His selection is regarded as a recognition of his past services and as an advancement to greater responsibilities.

Now, more than ever, industrial preparedness needs just such impetus as we have every reason to believe General Moseley brings to it. The selection of such an executive augurs well for a cause which possibly more than most others cannot stand still—unless it goes forward it is certain to lose ground.

When Winter Comes

THE winter season is about to begin bringing with it the period of meetings, conferences and discussions. Our local posts will soon again be in full blast. Conferences of Reserve Officers have already begun their fall and winter programs and the various boards of the Ordnance Districts and coöperating committees will soon be gathering for the discussion of industrial preparedness matters.

It has been our experience often in the past in attending gatherings of this nature to note that they are not always quite as interesting as they might be. Of course the subjects discussed are often times of a very weighty and technical nature and consequently are not what one might call especially entertaining. It is, therefore, as we see it, a very admirable thing to insert some note of the unusual in gatherings of this kind. We refer to the scheme adopted by the members of the Bridgeport Ordnance District at their last annual gathering. A great many of the leading officers not only of the district but from other localities, the Assistant Secretary of War, the Chief of Ordnance and others were present. Although satisfactory progress was reported by all division chiefs, the officers of the district were not content to confine their gathering to perfunctory progress reports. They have always sought to inject a note of novelty to vivify and vitalize these reports. The record of originality achieved in previous meetings was carried out when Maj. G. E. Tenney, who was called on to report for the Small Arms Division, reluctantly confessed that his heroic efforts to obtain last minute data by telegraph on the status of various procurement orders in the hands of his division had been unavailing and that consequently he could not report. This was the cue for a messenger waiting in the lobby to rush in with a telegraphed report on the status of District Procurement Order No. 27, accompanied by a sample of the order, the Colt automatic pistol caliber .45. Similar reports on other procurement orders in the small arms division, all accompanied by samples, followed in a continuous stream until the stage of the banquet hall took on the appearance of an embryonic arsenal.

Not all reports of committees can be rendered by telegraph as was done at Bridgeport for even telegrams can become monotonous, but at least there was the originality of the thing which is bound to stimulate interest.

Those in charge of meetings during the coming winter might put their wits together and think out worth while ideas of this sort. Too often the somber drone of statisties, requirements, calibers and ranges is conducive to sleep during the long winter's evening that otherwise might be extremely instructive if interspersed with an occasional laugh.

Timely Doctrine Well Stated

THE keynote address at the annual meeting of the Association sounded a very significant note when Hon. Benedict Crowell, our President, took occasion to remind members of the Association that there is nothing contradictory between the aims and purposes of our organization and the present international situation looking to naval disarmament. Indeed Mr. Crowell's statement deserved the very wide publicity it received in the press when he said that the Army Ordnance Association is for peace always, does not favor huge threatening armaments

is not militaristic and is not a group of war lords. "But we believe," he said, "that until humanity is made over, until jails and prisons are erased from our daily life, until the policeman has disappeared from our streets, there will be the necessity for adequate preparedness against war. Until peace negotiations have proved themselves as lasting as the history of man has proved resort to arms to be a fact, we believe that reasonable preparedness is one of the most assuring guarantees of peace."

Senator Hiram Bingham, President of the National Aeronautic Association, likewise stressed an important point in his reference to the correlation of aircraft and antiaircraft defense. He stated what we believe to be the basic theory when he referred to the important place antiaircraft armament holds for coast defense purposes. It is not difficult to imagine a situation where attacking forces having alluded both aircraft patrols and naval batteries might attempt a landing on our shores. In such an eventuality the antiaircraft armament would be indispensible. Having served in an important capacity in the Army Air Corps during the World War, and with his interest in civilian aeronautics as President of the National Aeronautic Association, we believe that he represents a majority viewpoint in placing such importance upon the necessity for antiaircraft defense.

General Williams' address, which due to lack of time was not given in full but which is published in its entirety in this issue of ARMY ORDNANCE, is another indication of the progressive spirit with which all ordnance problems have been handled under his leadership. Each year since the World War he has presented the country a record of sound advancement of army munitions performed by the vast organization of which he is head. The actual work as visualized in the new matériel—guns, ammunition, automotive vehicles, and the rest—is proof enough of this, not to mention the even larger task of current supply and issue to the services which goes along apace. We feel, in view of General Williams' masterful performance during the war and his fine record since, that all members will second Mr. Crowell's reference to General Williams as "the greatest Chief of Ordnance in the history of our Country."

Mr. Harold C. Smith, speaking for the metal trades and their willingness to coöperate in industrial preparedness matters, gave additional evidence of the whole-hearted interest our manufacturing organizations and primarily the metals industries have in the problems of national defense. Theirs is a great responsibility, and that they are measuring up to it in so splendid a way is proof not only that these industries are alive to the importance of the project but that the project itself is bound to meet with success when it has such active and willing interest.

Ordnance District Chiefs Meeting

FOR two days a group of industrial leaders representing fourteen ordnance districts and their staffs were assembled in Washington during the early part of October for their annual meeting. Much time was given to conferences, discussions with officers in charge of the work in Washington, and plans for carrying on the surveys and allocations of orders in the several districts.

That such gatherings are most helpful and even necessary goes without saying. First of all the National Defense Act imposes upon the supply services of the Army, of which the Ordnance Department is one, the obligation of industrial mobilization. With the obligation is the knowledge that the problem is an ever changing one. These gentlemen are perfecting a plan which requires constant thought and application. That they are willing to devote their time and thought to it is most gratifying, and there is every reason to believe that their work has found and continues to find full application in their contacts with industry. In defense matters especially, no plan is so planless as an obsolete one. In their endeavors to carry out the National Defense Act the country owes them a debt of gratitude for what they have done and what they are continuing to do so enthusiastically.

Much the Same in England

THOSE of us who feel that not enough money is being spent on national defense in America may find consolation in the fact that we have companions in misery abroad. Apparently the same policy of retrenchment is in decided vogue in England. The execution of present policy has induced the editor of the conservative *Army, Navy and Air Force Gazette* to state rather plainly the effect of the present retrenchment in Great Britain. Since there is much of similarity on both sides of the Atlantic, his words may contain reasonable ground for mutual condolence.

"When there is no war the Treasury is naturally tempted to save on the Army, the Navy and the Royal Air Force. This tendency is at its strongest in the early years of peace after a great and exhausting war. The outbreak of peace is always followed by the expression of good intentions, and politicians progress from the eloquent emission of sentiments of amity with the entire world to a belief that war has ended for ever. Because of this habit we have begun each war at a disadvantage, with the national armed forces lacking adequate reserves of men and material. * * * *

"A reduction in Army Estimates at the present time has special dangers. The Army is in a state of transition, as was the Navy in the early years of the present century. The introduction of the armored fighting vehicle is comparable in importance with the introduction of the 'dreadnought' type of vessel in 1906. The appearance of the 'dreadnought' made necessary a complete remodelling of the Navy and a general rejection of old ideas. The armored fighting vehicle makes necessary a remodelling of the Army. New theories and new practices have come, yet it is not possible to save money by alteration or removal of certain of the older types of formations. It is generally acknowledged that the Army of the future will be fully mechanized, but that day has not yet come. The experiments of the present time must be regarded as capital expenditure, but they are all necessary. Mechanization is expensive in its inception, but should produce many future economies, though that knowledge will not soothe Mr. Snowden in his search for easy money. Any restriction of the present series of experiments would be deplorable, as it might mean a loss to this country of the advantage gained by our lead in the development of armored fighting forces." With like-minded friends abroad we sympathize as we can well do from our own experience. The mechanized force of Great Britain is a pioneer in a branch of military development the value of which transcends reckoning. Its pioneering performance is an incentive to a fuller use of motorization in the national defense.

The Limitations of Preparedness Initiative

An Editorial

IT was Carlyle, Scottish essayist and historian, who after long research and investigation said, "Men have immense irresolution and inertia." General Barrows, in an address incident to the annual meeting of the California Post, Army Ordnance Association, applies in masterful fashion the Carlylean theory of leadership to things military of our day. He praises our progress such as it has been and decries our inertia such as it is. On both scores he talks plainly and straight from the shoulder and what he says is true. The matter may bear further scrutiny.

Sluggishness is an affliction which few mortals escape—the chairman of the board is as susceptible of it as the puddler, the professional man as much so as the laborer, and the professional soldier possibly more than any of the rest. One must admit on all sides the tendency to groove, to settle down, to let well enough alone.

MILITARY life produces such a tendency in a marked degree. Army regulations are a damper on initiative, they prescribe in infinitesimal detail the procedure that must be followed. Added to their inhibitions are the very nature of the work, the peace-time lack of general public interest leading often to antipathy. Routine and the old doctrines, sound and necessary though they be, are in themselves checks on military progress. Why, it would seem logical enough to conclude, should the Line of the Army keep its tactics in a constant state of flux when the wars of the past have proved their correctness? Why should the munitions designer scrap the tenets of years to try the untried and possibly fail? Why should the commercial manufacturer instruct himself in new methods of production when "during the war we did it this way," believing that in another war he or his successors will repeat the process in detail? Well, there is every reason why. If there are so many in industry who do not bother much about such matters, if there are few of the line and staff not afflicted with the professional inertia of which General Barrows speaks, then unless inertia is checked and remedied our whole system of military and industrial preparedness can become afflicted with dry rot and gradually revert to a mere cadaver.

Unqualifiedly we say, as General Barrows implies, that the technical branches of the Army are less afflicted with symptoms of inertia than the Line. In the field of munitions our progress is entirely creditable in weapons, aircraft and communications. We have kept apace with the progress of the machine age. As to matériel, we seem to be well ahead of our tested ability to use it. Our designs, our manufacturing plans and our supply organizations have their problems well in hand. Our tactics should be based upon the capabilities of our latest airplanes, our newest guns, our most modern vehicles and our latest communications. When these lag behind, then our defense program is out of balance and General Barrows' plea to eradicate professional inertia should be headed. After all, no military improvement is complete until its tactical advantage is utilized.

WE may be permitted to refer particularly to ordnance in this regard. It shows few evidences of professional inertia. As we have said, the designer may hold to traditions against all odds and still but exemplify an average human trait. But when, for instance as General Williams brought out in his address at Aberdeen, the very latest technique of welding processes as used in industry is being applied to gun manufacture with resultant economies and improvements, with this as one of many indicia, it cannot be said that inertia is rampant.

Again, during the current month a series of conferences is being held on the part of Ordnance Officers and the Ordnance Automotive Advisory Committee, a group of leading experts of the Society of Automotive Engineers, for the study of commercial automotive processes of manufacture and their application to ordnance automotive problems. Only recently similar conferences with the Ordnance Ammunition Advisory Committee, another civilian group, were held. Likewise the constant conferences with the many industrial executives and organizations that are a part of the Ordnance District system. With such an exchange of ideas constantly at hand, the probabilities of inertia are small. They may tarry at the drafting board or the lathe but they do not find place in the broader problems.

The same we believe applies to other technical branches. Aircraft, chemical warfare and communications are alive to civilian progress in related fields, and that progress is applied wherever possible to military uses. Allowing for the inertia inherent in us all, we cannot say that technical advancement is much impeded by it.

FOR the Line of the Army a word may be said. In major operations it is severely handicapped. Certainly it should develop tactics utilizing the newest advancements of matériel, but it is extremely difficult under the limitations imposed. Our troops are scattered over the continental United States and in the possessions; actual tactical maneuver on a large scale is difficult. More than that there is only the merest chance that new developments can be produced on a scale sufficiently large for general trial. Greater too is the demand for economy under which a real maneuver of great bodies of troops is impossible.

Inertia in matters of the acceptance of new principles based on new developments can be overcome entirely by coöperation. The Army as a whole must know what it wants and must know definitely. Once it does and thereafter if it retains an open mind and the will to progress, realizing that the producing agencies have only one purpose and that to give it the best of everything it wants, there is little room for improvement. If a stagnant tradition holds back the full application of this willingness and this progress to the defense services as a whole, then General Barrows' words stand not against any one individual or organization within the Army but against us, the people. In the final analysis the national defense is as efficient or as inefficient as we want to make it. Its inertia may be a direct result of our own.

Professional

The Deterioration of Mecury Fulminate When Stored Under Water

PRIOR to the World War the amount of mercury fulminate in storage was usually sufficient for current use only, but after the Armistice the War Department had a large surplus of this material on hand. Therefore it became an urgent matter to provide facilities for storage of this amount of explosive. On account of its sensitiveness, when dry, to blows or friction, mercury fulminate is kept under water when in bulk storage. The question arose as to how long mercury fulminate would remain stable under such storage conditions.

Normal Crystals of Mercury Fulminate.

G. S. Heavens (J. S. C. I., 1919, Vol. 57, p. 144) states that mercury fulminate is partly decomposed by hot water; yellow basic salts being formed by hydrolysis. According to W. R. Miller (*Memorial de l'Artillerie Francaise,* Vol. 4, p. 4), solution of mercury fulminate in boiling water is accompanied by partial decomposition and the formation of some fulminurate $(C_3H_3N_3O_3)_2$ Hg_3. The same writer also makes the statement that mercury fulminate is not stable in any solvent if contact is prolonged sufficiently. The decomposition in hot water described above has been confirmed by work at Picatinny Arsenal. After heating mercury fulminate and distilled water for four weeks at 50° C., a yellow decomposition product was found present. Heating over-night in distilled water at 70° C. caused mercury fulminate to deteriorate from 98.63 to 90.23 per cent purity with the formation of the usual yellow decomposition product.

The above information being of limited applicability to the work at hand, experimental storage tests were begun in 1921. In service storage of mercury fulminate, 150 pounds are placed in a heavy canvas bag suspended in the center of a cask and surrounded with sawdust saturated with water. The place of storage is usually a cave in which the temperature during the winter does not reach the freezing point of the water in the cask and a fairly low temperature obtains throughout the summer. These conditions were simulated in the experimental work described herein. Portions of about one pound of mercury fulminate, manufactured in 1918, were stored under several types of water, i. e., distilled water, sea water, alkaline water high in carbonates, and alkaline water high in sulphates. Chemical and physical tests were made annually, the results of which are given in table herewith.

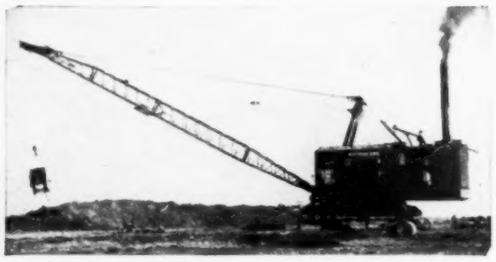
Crystals of Mercury Fulminate Showing Etchings by Salt Water.

ANNUAL TEST RESULTS OF MERCURY FULMINATE IN STORAGE AND UNDER WATER OF SEVERAL TYPES

Nature of Water		Distilled	Sea Water	Alkaline High in Carbonates	Alkaline High in Sulphates
Determination of Mercury Fulminate	1921	99.56	99.56	99.56	99.56
	1922	99.10	99.42	99.30	99.19
	1923	98.89	91.12	99.05	98.75
	1924	98.78	86.25	93.65	98.78
	1925	98.85	85.85	96.35	98.52
	1926	98.26	82.05	95.82	97.73
Sand Test—Sand through 30 mesh crushed by one gram.	1923	37.7	34.2	37.1	37.7
	1924	37.4	5.6	36.8	37.3
	1925	36.6	4.0	36.0	36.4
	1926	35.4	3.9	37.7*	38.5*

*These values are slightly high due, no doubt, to unavoidable variations in the sand test.

Evidently deterioration under distilled water takes place but at a rate so slow that at the end of eight years the specification requirement of 98 per cent purity was still met. Sea water causes extremely rapid deterioration, carbonate water less, and sulphatic water almost approximates distilled water. The last is to be expected, since the sulphate ion is comparatively nonreactive. Except in the



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case of mercury fulminate in storage in sea water, the contents of thiosulphate insoluble matter and free mercury were at all times well within the specification requirements of 2 per cent and 1 per cent, respectively. The effect of the sea water was to increase the insoluble matter to as high as 6.87 per cent and the free mercury to 1.25 per cent.

If the above data for purity and for brisance as determined by the sand test are plotted against time for each type of water, it is noted that the deterioration in purity is practically a straight line function in each case. The rate of deterioration depends on the type of water. The effect on the brisance is approximately the same. Evidently no deterioration took place during the first year in any one of the storages. During the second year the effect of sea water on fulminate became apparent in the decreased purity, and this was found to be accompanied by a decrease in brisance. During the subsequent years the deterioration of fulminate under sea water was evident in both analysis and sand test, but this was too slight with the other waters to be reflected accurately in the sand test. The attached photomicrograph shows the mercury fulminate crystals etched by the sea water. These conclusions can be applied practically. If storage is to be made on a seacoast, precautions should be taken to avoid the use of fresh water contaminated by sea water as the result of tides. The underground waters of limestone regions should be avoided. The sulphatic waters of the west present no problem in use. Storage should always be made under as pure water as possible, rain water being the practical answer to this.

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New Bomb-aiming Apparatus

EXPERIMENTS are being carried out at the Army Air Corps' experimental laboratory at Wright Field, Ohio, with a view to the development of a bomb-aiming apparatus which will greatly increase the accuracy in dropping bombs from airplanes.

The device will be on the order of an aiming apparatus which will enable the pilot to determine more accurately the methods and time by which the projectile may be dropped.

The existing bomb-aiming apparatus is fairly accurate. It is built along the side of the fuselage of the plane and has adjustable parts which can be set for the desired ranges according to the elevation, speed and drift. It is possible with devices now in use to hit the outline of a battleship on the ground with a large percentage of accuracy from an elevation of from 4,000 to 5,000 feet. If the bomb lands within 20 feet of the target it is counted as a hit, but greater accuracy is desired.

The Army Air Corps has also worked toward the perfection of bomb-releasing devices. The instantaneous release of the projectile on the instant the pilot touches the release button has been the main field for improvement, as such devices have little to do with the accuracy with which the bomb is sent toward the target.

The pilot has to fly straight and make proper allowances for speed, elevation, drift and range when aiming the bomb and improvement in aiding this is the object of present experiments.

To Test New Pursuit and Observation Planes

TESTS are soon to be started, according to Assistant Secretary of War F. Trubee Davison, to determine the performance and military value of two-place pursuit planes and three-place, twin-motored, long distance observation aircraft. At present, all Army pursuit is of the single seater type, while observation ships have only one motor and carry crews of two.

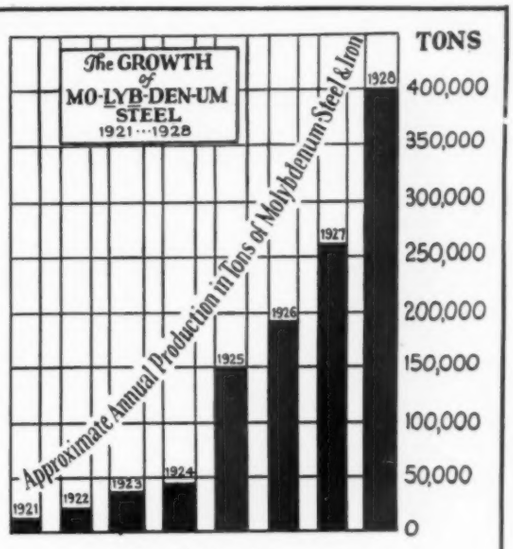
"The tactical usefulness, as well as flight performance of these new types must, of course, be thoroughly tested before we can determine how they fit into the air defense program" said Mr. Davison. "It will be some time before the planes are ready and even more time will lapse before trials will have been completed. We are, however, extremely hopeful that the experiments will result in the development of new branches of pursuit and observation aviation and increase the efficiency and effectiveness of our Army air defenses.

"The new pursuit plane, instead of carrying only one man and two machine guns, will carry two men and three guns. It is believed to be capable of greater speed and greater ceiling than types now in use. Just how extensively the development of two-place pursuit planes will affect present pursuit tactics remains to be seen, but it is worth while to point out with great emphasis that the rear gun should eliminate the most defenseless spot in pursuit flying. So far, the aim of a pursuit pilot has been to get on the tail of his pursuit opponent in order for him to sign the latter's death warrant, because at present the only pursuit weapons are the forward shooting machine guns in the nose of the ship. With a gun covering the rear of the plane the situation changes as the rear gunner can put up a strong defense and make the position of the attacking pilot extremely unhealthy.

"The bi-plane pursuit plane is no larger than the present singleseater. The gunner is placed in a small compartment with his back to the pilot and is protected from the blast of the propeller by a windshield. Unlike the rear gunner in observation planes, he does not stand up in order to handle his weapon, but is seated with his eyes almost flush with the edge of the cockpit. Fixed to a low post on the fuselage is a machine gun which covers and protects the rear of the plane. It is not possible at this time to discuss the equipment or performance of the new ship nor the specific uses to which it may be put, for various reasons dictated by policy and also because it is an experimental type which we do not as yet know a great deal about.

"As for the new long distance reconnaissance plane, that, too, is a distinct novelty in Army Air Corps equipment in more than one respect. It is a monoplane equipped with two powerful motors and is designed to fly or climb on one engine. So far our only monoplanes have been in the cargo class. The new observation craft is also believed to have a wider cruising range and higher speed than observation planes now in use.

"These ships carry crews of three men in tandem—observer, pilot and gunner. The observer is located in the front cockpit and on account of the monoplane design he has exceptionally good visibility in all directions. The plane will be equipped with a powerful long range radio set so that it will be in constant communication with its ground station and able to make continuous reports on



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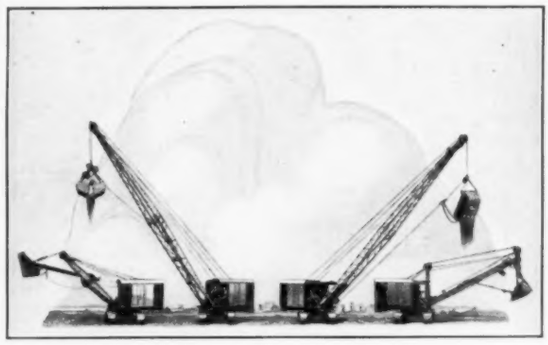

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"Observation is a highly important branch of military aviation. The observation plane is not alone the 'eyes of the Army' but also the eyes of its brother outfits—bombardment and attack. On account of the impossibility of designing any single type of observation airplane which fully meets the many and varied observation needs, we deem it highly essential to take steps to test types of observation aircraft suitable for all occasions and it is in conformance with this aim the new planes are being acquired."

Ordnance Department Will Test Carden Loyd Light Armored Vehicle

THE Secretary of War has approved the recommendation of Maj. Gen. C. C. Williams, Chief of Ordnance, U. S. A., for the purchase of one Carden Loyd light armored vehicle from the Vickers-Armstrong Company.

This vehicle will be developed as an infantry carrier of the mechanized force. In all the studies of the mechanized force one of the principal vehicles from the point of view of the infantry component has been such a vehicle. It is a low, cross-country machine, intended to transport half an infantry squad or half a machine-gun squad with its guns and ammunition. The War Department plans for the mechanized force, which were approved in principle some time ago, listed such a vehicle as one of the most important items for development. For a long time also the infantry has sought some mechanical vehicle which would replace the mule and the cart in the transportation of its machine guns and special weapons. The plans for the mechanized force visualized that if such a vehicle were developed for it, it would also be a step toward the possible solution of its problem for divisional infantry.

The characteristics of the Carden Loyd light armored vehicle are its small size, low target, light weight (about 3,000 pounds), and its combination of mobility on tracks across country or on wheels on the road. It is powered by a commercial engine and has a type of track which is the result of several years of experimentation.

It is expected that the acquisition of this vehicle will be an undoubted step forward in the development for any mechanized force in our Army.

The Carden Loyd weighs from 3,000 to 6,000 pounds, is 8 feet one inch long, 5 feet 7 inches wide, 4 feet high, has a maximum speed of 28 miles per hour, 3 gear speeds, is engined by a Ford Model T engine of 30 horsepower, has a capacity of two men and one machine gun and ammunition, a cruising radius of 100 miles, and has an armor thickness in front of .35-inch and on the sides of .24-inch.

New Ammunition for 75-mm. Mortar

NEW ammunition for the 75-mm. infantry mortar has just been developed by the Ordnance Department and has proven successful in recent trials. The ammunition is characterized by a tail-like projection at the base of the projectile, having on its end a number of vanes. It also has the general appearance of an aerial bomb. The tests which have been conducted by the Infantry Board at the Infantry School at Fort Benning, Georgia, have been so

gratifying as to bring about a decision to manufacture a number of mortars with the necessary ammunition for an extended service test.

Following the World War, a 75-mm. rifled mortar was developed for infantry use. The mortar, although satisfactory, had two undesirable characteristics, namely a minimum range of 600 yards, and the tendency of the projectile to excessive and variable drift. In an effort to correct these troubles, the Ordnance Department developed the vaned projectile which is used in the same 75-mm. infantry mortar having a smooth bore. Recent demonstration firing with the new ammunition before the Infantry Board at Fort Benning, Georgia, indicates that a minimum range of 300 yards can now be obtained and that the objectionable drift of the projectile has been eliminated.

Books

Elements of Business Finance. By Joseph H. Bonneville. New York: Prentice-Hall, Inc. $5.00.

WRITTEN for the sole purpose of providing a text for the use of colleges or universities in a course on Business Finance, the author has nevertheless succeeded in producing a book of universal appeal on this subject for all who have some slight background in economics and accounting principles. In a lucid and readily comprehensible style Professor Bonneville describes the process of promoting a business, the various forms of organization it might take, with special emphasis on the corporate form, the characteristics of stocks and bonds in considerable detail, and other phases of financial organization.

Field-Marshal Earl Haig. By Brig. Gen. John Charteris, C. M. G., D. S. O., M. P. With a foreword by John Buchan. New York: Charles Scribner's Sons. 1929. $6.00.

THE author of this biography served as one of Marshal Haig's principal staff officers in India, at Aldershot and in France. While it is yet too early to expect a final and fully authoritative estimate of Haig, when written it must be based on first hand and contemporary works such as General Charteris' excellent book.

The author's admiration for his chief, while evident, is well restrained and the book leaves one with a picture of a thoroughly human being. One is particularly impressed with the fact that, as in Grant's case, it was ruggedness of character and singleness of purpose rather than genius that made Haig a successful leader. Haig was a man of few words, few intimate friends and few avocations. He was a soldier through and through with an exceptionally strong character, an intense devotion to his profession, and high ethical and moral standards. His devotion to duty is particularly shown by his submission to the Cabinet, freedom from intrigue and lack of political activity; it is in marked contrast to his contemporary and partial antithesis, Field Marshal Sir Henry Wilson.

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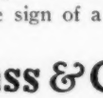
Waterbury, 

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The author has been notably successful in so describing Haig's campaigns on the Western Front as to make the strategic and major elements of his operations stand out clearly in logical and chronoligical order unconfused by the many local attacks and the day-to-day fighting. Very few writers on the World War have achieved this. The author shows well that Haig was badly handicapped by political interference and by the Cabinet's insistence on spreading the British efforts over many parts. Further, like nearly all the generals in the World War, his plans were often mired in execution by the vastness of the forces he handled; in the next war smaller mechanized forces will restore to warfare the opportunities for brilliant maneuver so characteristic of the military genius.

It is altogether a very valuable work on one of the great captains of all time and will hold the reader's interest easily. While the author is concerned principally with Haig, the leader, enough details of his life are given to make one know him. The book contains illustrations, maps and an index.

Introduction to Crystal Analysis. By W. H. Bragg. New York: D. Van Nostrand and Co. 1929. $4.25.

THE evolution of human intelligence has been a progression in the understanding of the facts of nature. Civilization has been built upon the useful exploitation of this knowledge. The bold concept of Prof. Laue that X-rays can be diffracted by the geometrical arrangements of the atoms in crystals marked a real step in evolutionary progress. The Braggs, father and son, have taken a foremost position in interpreting Laue's discovery for the benefit of civilization. Their book, "X-Rays and Crystal Structure," remarkable for its simplicity and clarity of expression, opened new vistas to the imaginative thought of millions and gave the world of physical science a new tool of research.

We have now from the hand of Sir William a new book, a fit companion to its predecessor. In the previous book he has pictured for us atoms and molecules as the ingredients from which he, with magical skill, constructs the unit cells of the crystalline solids of nature. In the new book he presents us with analytical methods by means of which the spots or lines in a diffraction pattern may be interpreted in terms of atom spacings and locations. His presentation for the most part is characteristically lucid and his diagramatic illustrations of concrete examples are wonderfully instructive.

Much of his material reflects his own scientific contributions, but he has drawn also generously upon the voluminous literature that has grown up since the presentation of his first book. He recognizes work done in America in applying X-ray analysis to industrial problems. The survey of such applications is fairly complete but emphasizes the fact that this field has as yet been but little developed. Particularly the results achieved with metals, although important, rather point the way for future work than mark any completed development. The rapidly increasing importance and complexity of mechanical structures is causing engineers to be more and more concerned with the physical properties of their materials of construction. They are demanding ever higher standards of strength, endurance

and dependability. Many industrial laboratories in this country and abroad are sensitive to this demand and are turning to X-ray methods of analysis in the hope that they may assist in solving some of the problems involved in meeting it. For the men in these laboratories Professor Braggs' book will fill a real need. It is to be regretted that the chapter on metals could not be more comprehensive for the benefit of such workers. It is to be hoped that the present book will be followed by later editions in which the accumulation of new data will make possible a large expansion of the parts devoted to industrial applications, in particular as they relate to materials of construction.

Three Persons. By Sir Andrew Macphail. New York: Louis Carrier & Co. $3.50.

THIS is an account and an estimate of three of the War's big reputations—Sir Henry Wilson, Colonel House, and Colonel Lawrence. Each has published his memoirs.

Sir Andrew not only mercilessly convicts Sir Henry Wilson by his own words from his published diary but he bitterly assails him for considering the war as a game. "English soldiers have never been gifted in this form of intelligence and our high command was bereft of that most decisive instruction. Paschendale was the result."

With Colonel House, Sir Andrew is far gentler. He states "When Woodrow Wilson took upon himself the good of humanity, the management of the world, Colonel House was compelled to assume the government of the United States and in moments of stress to assist in the larger operation as well." He attributes no mean motives to Colonel House but he simply misunderstood. He never fully comprehended the tremendous impetus behind a great war. The propriety of leaders of industry having to consult in secret with a private person is questioned.

Lawrence of Arabia is shown as an artist in addition to his other qualities. The war in Arabia was a minor war. Victory came on the western front so Lawrence's achievements were not British victories. If he seemed to shrink from publicity, he succeeded admirably in obtaining it.

Sir Andrew's method is strong but it is refreshing to get clear of the disillusionment that hovers over these three persons who bulked large in the news but who had little to do with the final outcome of the war.

The Bridges of Pittsburgh. By Joseph White and M. W. von Bernewitz. Pittsburgh: Cramer Printing and Publishing Co. 1928.

IN addition to the forty-three large river bridges over which more than 150 million tons of freight in trains and under which glide more than 30 million tons of raw materials and finished products pass annually, there are nearly 500 smaller structures which go to make up Pittsburgh and its environs, "The region of bridges."

Messrs. White and von Bernewitz present in this elaborately illustrated volume a compact and simple record designed to stimulate wider knowledge and recognition of the bridges of Pittsburgh "conceived by farseeing citizens, promoted by progressive public, railroad and industrial officials, designed by skilled architects, constructed by enterprising steel-making and bridge-building companies, and erected by fearless workmen."

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ABC of Aviation. New York: The Norman W. Henley Publishing Company. 1929.

FOR some time past, there has been a demand for a simple work in everyday language, defining the principles governing flying machines and airships. This book has been prepared by a recognized aviation expert for the benefit of young people and non-technical readers who wish a low priced, yet reliable introductory treatise to the study of aeronautics. While the matter included is a popular discussion, general in scope, the reader will have no difficulty in securing a good basic knowledge of various aircraft types and why they fly.

The study of aeronautics involves distinct types of machines which operate on different principles so this treatise considers both lighter-than-air and heavier-than-air flying machines. A complete introduction prepares the reader for a proper understanding of the large possibilities of aviation, then various types of balloons and airplanes are described and illustrated.

Armaments Year Book. Geneva: League of Nations. 1929.

THE Armaments Year Book is published in pursuance of the decision taken by the Council of the League of Nations in July, 1923, and in conformity with principles laid down by the Council and the Assembly of the League. The present edition contains up-to-date monographs on 60 countries, both members and non-members of the League of Nations.

The defense systems of the countries included in the text are treated under three general categories: 1st, Army and Navy; 2nd, budget expenditure allotments; and 3rd, raw materials and differents products of importance for national defense—this latter having been compiled in connection with Article 8 of the Covenant according to which the exchange of information between all states has to include "The condition of such of their industries as are adaptable to warlike purposes."

Data included under "Armies" are (a) the supreme military authority and its organs; (b) territorial military districts; (c) higher formations: army corps, infantry divisions, cavalry divisions, etc.; (d) arms and services: infantry, cavalry, artillery, ordnance, etc.; (e) police forces: gendarmes, customs officers, etc.; (f) equipment required by various units; (g) system of recruiting; (h) budget establishment of the army and of the various arms; (i) Cadre, recruiting, promotion and schools; and (j) preparatory military institutions.

The Old Army, Memories 1872-1918. By James Parker, Brig. Gen., U. S. Army, Retired. Philadelphia: Dorrance and Company, 1929. $4.00.

THIS is a very interesting book, concerned mainly with the Army experiences of General Parker, but full of intimate glimpses of his Army contemporaries and others with whom his duties were concerned. It is interesting to consider the author's experiences in Indian warfare and in the Philippines with those of his classmate, Major Gen. Hugh L. Scott, who has recently produced an excellent book dealing with his Army life. There is much in these books to inspire officers to endure hardships and adversity and to devote themselves wholeheartedly to the task at hand and

to take consolation in the satisfaction of duty well performed when praise and appreciation from those for whom they serve is seemingly lacking.

Following his account of the earlier years of his Army duties the author devotes considerable space to the Spanish-American War and the Philippines. The characteristics of the various tribes with which he found himself and their modes of warfare are described in sufficient detail to quailfy the author as a thorough student of the problems encountered there. Having thus shown his intimate knowledge of his subject General Parker then advocates that the United States fulfil its promises and grant these peoples self-government, a feeling that has many adherents.

There is a note of sadness in the concluding chapter, that of the energetic Army officer being retired for age and forced to assume an inactive life when his heart is full of devotion for the service. It is believed, however, that the author should feel satisfied that in making these "Memories" available to those officers who are to follow in his footsteps he is accomplishing much for the Army of today.

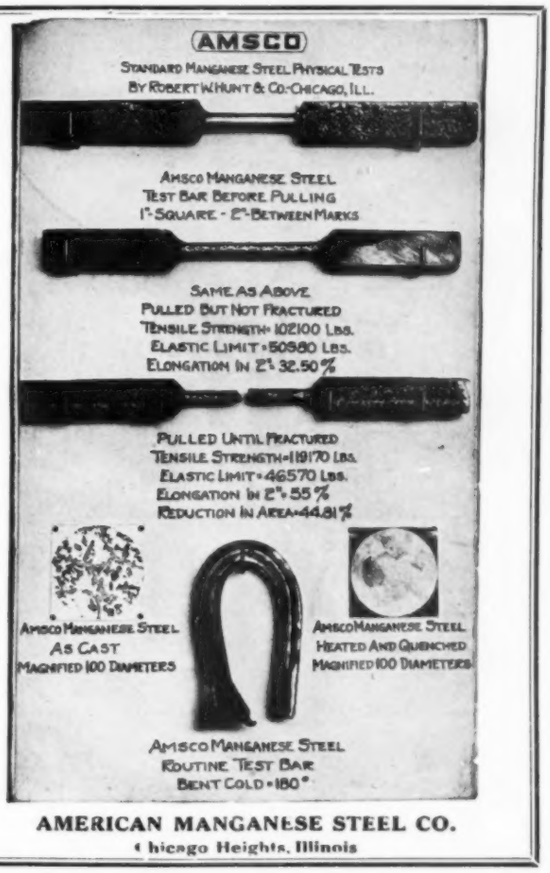
Suicide Battalions. By Wendell Westover, Capt. 4th Machine Gun Battalion, A. E. F. New York: G. P. Putnam's Sons. 1929. $5.00.

CAPTAIN WESTOVER is a product of the Plattsburg Training Camp and served as an instructor in the First Officers Training Camp, finally accepting an appointment as a provisional 2nd lieut., Regular Army, rather than a commission as a captain in the National Army.

He sailed for France in September, 1917 as a lieutenant in a provisional machine gun battalion. He served eight months as a platoon commander in "A" Company, then as Company Commander of "B" Company, 4th Machine Gun Battalion, 2nd Division (Regular) A. E. F.

Captain Westover tells the story of the battalion in the making, the training behind the lines and in quiet sectors. In action at Chateau Thierry, Soissons, St. Mihiel, the Champagne and in the Meuse Argonne Offensive, he clearly portrays the duties of an officer of a machine gun company.

Of especial interest to readers of ARMY ORDNANCE are his comments on the work of the 2nd Mobile Ordnance Repair shops: "There the Division Ordnance Repair Shop overhauled the guns with such expert efficiency that the gunners took increased pride in them and showed impatience for real opportunities for their use."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